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REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

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AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

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REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH
DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

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JOHN MURRAY

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ZOOLOGY—VOL. XV.

PART XLIII.—REPORT ON THE POLYPLACOPHORA.

BY ALFRED C. HADDON, M.A., M.R.I.A.

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EDITORIAL NOTE.

THE present Memoir forms Part XLIII. of the Zoological Series of Reports on the Scientific Results of the Expedition.

On the return of the Expedition to England, the whole of the Mollusca, except the Cephalopoda and Pteropoda, were placed in the hands of the Rev. Robert Boog Watson, F.L.S., for examination and description. After separating out the whole collection and labelling the greater number of known species, Mr Watson found it necessary to limit his investigations to the larger groups of the Gasteropoda and Scaphopoda. The collection of Lamellibranchiata was subsequently handed over to Mr E. A. Smith, and his Report has been already published. The Nudibranchiata and several smaller divisions were distributed among other Naturalists.

The Polyplacophora were placed in the hands of Professor Haddon, and the results of his examination are given in the following pages.

JOHN MURRAY.

CHALLENGER EXPEDITION OFFICE, 32 QUEEN STREET,
EDINBURGH, *August* 9, 1886.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the POLYPLACOPHORA collected by H.M.S. CHALLENGER during the years 1873–76. By ALFRED C. HADDON, M.A., M.R.I.A., Professor of Zoology, Royal College of Science, Dublin.

INTRODUCTION.

THE number of specimens of the Polyplacophora, or Chitons, collected by the Challenger Expedition was very small, considering the frequency and wide distribution of the group. This is to be accounted for by the fact that the majority of Chitons are strictly littoral in their habit, and the Expedition occupied itself mainly with deep-sea dredging. About eighty specimens were collected, which are referable to fifteen genera and thirty species, of which seven were previously undescribed, and others, though described, had not been figured.

The really deep-sea Chitons all belong to the genus *Leptochiton*, and, judging from their sculpture, they are closely related forms. *Leptochiton alveolus*, Sars, which may be taken as the type of this series, occurs off the west coast of Norway at from 150 to 420 fathoms, and has also been dredged from 220 fathoms in the Gulf of St Lawrence, from 150 fathoms in the Gulf of Maine, and northwards along the east coast of North America beyond New England waters, from 99 to 640 fathoms, a region which is swept by Arctic currents. *Leptochiton belknapi*, Dall, has been dredged from 1006 fathoms (bottom temperature 35°·5 F.) in the North Pacific, near the Aleutian Islands, and by the Challenger Expedition off Cape Bolinas, Luzon, Philippine Islands from 1050 fathoms (bottom temperature 37°). Another allied species, *Leptochiton benthus*, n. sp., also from the North Pacific, 15° north of Hawaii, Sandwich Islands, from 2300 fathoms (red clay, bottom temperature 35°·1), attains the greatest depth which has hitherto been recorded for any

Chiton. The third example of this genus collected by the Expedition is *Leptochiton kerguelensis*, n. sp., from Royal Sound, Kerguelen, at a depth of 60 fathoms (bottom temperature 40°). *Leptochiton cancellatus*, Sow., which is a coast and comparatively shallow water form of Northern Europe, being found down to a depth of 300 fathoms off Lofoten, extends from Vigo, Spain, to Greenland, and off the Canadian coast in the North Atlantic down to 300 fathoms. Dall also dredged it at Alaska in from 6 to 100 fathoms. Thus *Leptochiton* may claim to be an Arctic or north temperate genus, which also ranges to great depths, at least in the North Pacific.

Another Leptoid genus, *Hanleyia*, also appears to flourish better in colder waters. *Hanleyia debilis*, Gray, is found in British seas northwards. Sars dredged it near North Cape in from 25 to 300 fathoms, and the U.S. Fish Commission in Massachusetts Bay, from 38 fathoms. *Hanleyia mendicaria*, Migh. and Ad., occurs at Casco Bay; Grand Manon; Portland Harbour, Maine, the deep water specimens being much larger than those from shallow water. *Hanleyia* (?) *abyssorum*, Sars, comes from 150 to 200 fathoms off Bergen, Norway. *Hanleyia tropicalis*, Dall MS., is a large and beautiful species from 128 fathoms, Sand Key in the Gulf of Mexico (Dall). The allied genus *Hemiarthrum* has only one species, *Hemiarthrum setulosum*, Carp., which the Expedition collected from the shore of Kerguelen Island.

Of other Chitons from moderately deep water the following may be noted: *Chætopleura apiculata*, Say, from 100 miles S.E. of Martha's Vineyard, Mass., at 210 fathoms (bottom temperature 40°·5 F.), Dall, Proc. U.S. Nat. Mus., 1882, p. 410. The Expedition dredged *Lepidopleurus dorsuosus*, n. sp., at 310 fathoms off Prince Edward's Island, and *Lepidopleurus dallii*, n. sp., off South Chili from 400 fathoms (bottom temperature 46°·5); *Plaxiphora carmichaelis*, Gray, 345 fathoms, South-West Chili (bottom temperature 46°), and *Plaxiphora simplex*, Carp. MS., was collected on the shore and dredged from 110 fathoms at Tristan da Cunha. Several species of the genus *Trachydermon* and other genera occur at low water and at moderate depths down to about 100 fathoms.

The general distribution of the shore Chitons is now fairly well known, and the specimens collected by the Expedition present us with no new features of interest.

This Report, however, brings out still more prominently the necessity of a large number of specimens being collected from as many localities as possible. In some groups especially there is a great tendency to individual variation, so that an unnecessary number of new species have been described, or, at all events, they have been so described as to mask their real affinities. In order to solve the problems of Geographical Distribution, and to learn the true lesson of the variability of species, it is indispensable to compare large series of specimens, and, while accurately noting and tabulating varieties, to be very careful about describing them as species. For the sake of convenience, well characterised or locally restricted varieties may advantageously receive some varietal designation, and it would be preferable if this could convey some reference to the type or central form. If

this could be satisfactorily accomplished the all-important analytical method would not overwhelm the synthetical, as it has been too often allowed to do by systematic zoologists. The forms which are associated with the names of *Acanthopleura picea*, *Acanthopleura spiniger*, and *Acanthopleura incana*, illustrate this point very forcibly.

The critical study of local varieties will lead to valuable results, and is a vastly better employment than the indiscriminate description of so-called "new species."

Various conchologists have attempted to collect the species of Chitons into consistent genera and greater groups, the last and best essay in this direction being that of the late Dr P. P. Carpenter of Montreal, who unfortunately died before he was able to publish his monograph. The more salient features of Dr Carpenter's system have been given by Mr W. H. Dall of Washington, in two valuable papers On the Scientific Results of the Exploration of Alaska, Article IV., Report on Chitons,[1] and On the Genera of Chitons.[2]

It would necessitate the comparison of a greater range of species than occurs in the collection to enter into a profitable critical discussion concerning the correctness of the main ideas in Carpenter's classification. It should be remembered that as a systematic conchologist he regarded the classification of Mollusca from a somewhat different standpoint from that of the modern school of morphologists, and his aim was to frame a scheme which would indicate the general relationship of forms, and which was based upon characters readily observed even in dried specimens. Although this necessarily limits the field of comparison, a great deal can be said in its favour for practical purposes, as, to take a definite example, it is manifestly impossible for those who have charge of public collections to dissect or mutilate specimens for an anatomical investigation, even had they the time or did the material permit of it. The systematic zoologist can only take certain patent characters for taxonomic purposes; it is the duty of the morphological zoologist to test these eclectic characters by all the means of his research. A true conception of the affinity of forms can only be reached by a nicely balanced appreciation of all the characters, and it is upon such that any classification must be based which will have any permanent value.

I had hoped to include in this report a sufficient account of the anatomy of the group which would enable us to test the value of Carpenter's classification. Although I have made some progress towards this end, various circumstances have prevented it from being here carried out. The species collected by the Challenger Expedition are not sufficiently representative for that purpose, and I have not yet had time to work out the supplementary material kindly placed at my disposal by Mr Dall. In the meantime, I adopt in the main Carpenter's classification and terminology.

In this report the species will be treated from a purely systematic point of view, and only those characters which are of ordinary taxonomic importance will be noted.

I have employed the terminology in general use, and have added but one new term.

[1] *Proc. U.S. Nat. Mus.*, 1878. [2] *Proc. U.S. Nat. Mus.*, 1881.

The shell consists of eight valves, of which the anterior and posterior invariably differ from the six intermediate valves; the anterior portion of the last valve resembling the central areas of the intermediate valves, while its posterior portion resembles the anterior valve; this valve is thus naturally divided into an anterior area and a posterior area. The intermediate valves are similarly divisible into two areas, the central area and the lateral area. The former extends along the whole length of the ridge of the valve down to the lateral border. The surface markings of the median dorsal line or jugum usually differ somewhat from those of the lateral aspects of the central area, and for these areas I propose and have adopted the term *pleura* (from πλευρόν, τό, in plural, the ribs, side). Each central area thus consists of a median jugum and a pair of pleura. The coloration of the area is occasionally different in the two regions. The apex or umbo is the posterior termination of the jugum, and rising more or less close to it, the lateral areas of the intermediate valve diverge obliquely forwards. The surface marking of the lateral areas of these valves usually closely resembles that of the anterior valve, and the posterior area of the posterior valve.

In this report I have adhered to the principle of describing the direction of the various kinds of ornamentation in terms which bear relation to the animal as a whole. Thus, longitudinal and transverse apply to the length and breadth of the animal, and the length of an intermediate valve is its antero-posterior axis. Radiating markings are naturally those which diverge from the umbo to the periphery.

The exposed or upper surface of the shell is the tegmentum, which differs markedly in its appearance and structure from the under surface. Although intimately connected together, it is convenient to regard the shell as composed of two concentric and quite distinct portions, the upper or tegmentum forming a cap which leaves the edges of the lower or articulamentum more or less exposed. The tegmentum is raised above the articulamentum, and at its periphery it usually more or less projects over the articulamentum, forming the eaves or subgrundæ. There is great diversity in the relative development of these two layers of the shell, the articulamentum being most rudimentary in the Leptoidea and having its maximum development in the Chitonelloidea.

The articulamentum is in the intermediate and posterior valves produced anteriorly into a pair of broad thin plates, the sutural laminæ, the bay between them being the jugal sinus (*sinus jugalis*). The lateral border of the articulamentum of the intermediate valves is indented by a distinct notch, the lateral slit which demarcates the anterior from the lateral insertion plates or side laminæ of insertion. These are absent only in the Leptoidea and Chitonelloidea. Except in the Leptoidea, the articulamentum of the anterior valve always more or less projects, and is slit or notched, forming a variable number of teeth; the same occurs for the posterior border of the last valve except in the Leptoidea, Schizoidea, Placiphoroidea, and Chitonelloidea.

There is, as a rule, a considerable range of variation in the relative development of the

parts of the valve, number of slits, &c., even in closely allied forms; thus care must be taken not to lay too great stress on any one series of characters.

The shell is more or less imbedded in and entirely surrounded by the girdle or zona, the upper surface of which is variously covered with scales, spines, bristles, hair, or down. The nature of the girdle forms a valuable auxiliary for systematic purposes, as the character of the covering is usually very constant in the different groups. In certain genera, groups or even large tufts of spines or bristles are placed in pairs near the sutures between the valves, and there are usually two on each side round the anterior valve, making a total of nine pairs of tufts; the tufts arise from depressions in the surface of the girdle, which are termed pores: in *Acanthochiton*, for example, these pores are often very deep pits. The terms which are employed to indicate the different kinds of girdle armature merely have reference to their appearance, and have no morphological significance; all of them have a chitinous matrix, which is more or less completely infiltrated by calcareous salts. The under surface of the girdle is characterised by possessing delicate elongated flat scales.

Another character which is worthy of notice is the number and extent of the gills; these are fewest in number in the Leptoidea, and reach their maximum development in the Lophyroidea, Acanthoidea, and in the higher Ischnoidea.

Professor Moseley has suggested the utilisation of the arrangement of the megalopores and micropores of the shell for classificatory purposes. My researches on the structure of the shells are not at present sufficiently complete to enable me to test the accepted divisions of the group by this means. The histological structure of the tegmentum and the distribution of the dermal processes (megalæsthetes and micræsthetes of Moseley) will, however, prove of the greatest value and interest.

I must take this opportunity of acknowledging my great indebtedness to my friends Mr W. H. Dall, of the Smithsonian Institution, Washington, and to Mr E. A. Smith, of the British Museum, who have at all times given me the benefit of their experience. To the former I am further indebted for being permitted to examine Dr Carpenter's MS., which Mr Dall has in his possession, and for the gift of several rare species of Chitons.

The collection of Chitons was first forwarded to the Rev. R. Boog Watson, who had named a few of them, and to whom I am indebted for some valuable clues.

I have taken the following table from Dall's paper On the Genera of Chitons, to serve as a key to the genera mentioned in this report, without however committing myself to its entire acceptance, as it is better to leave the table as it stands than to make alterations which would only be partial and incomplete. In the case of the Leptoidea only have I given a synopsis of the genera of the group. Its introduction serves to elucidate the concluding remarks concerning the probable line of differentiation within the order.

TABLE OF THE GENERA OF RECENT CHITONS.

Order POLYPLACOPHORA.

Section I.—CHITONES REGULARES.

Head and tail plates similarly articulated.

A.—Leptoidea.

Insertion plates obsolete, or, if present, unslit.

Leptochiton, Gray.
  a. *Deshayesiella*, Carp.
Hanleyia, Gray.
Hemiarthrum, Carp.
Microplax, Adams and Angas.

B.—Ischnoidea.

Insertion plates sharp, smooth, fissured; with eaves.

**No pores on girdle.*

Trachydermon, Carp.
  a. *Trachyradsia*, Carp.
Callochiton, Gray.
  a. *Stereochiton*, Carp.
Tonicella, Carp.
Schizoplax, Dall.
Leptoplax, Carp.
Chætopleura, Shuttleworth.
  a. *Maugerella*, Carp.
Spongiochiton, Carp.
Ischnochiton, Gray.
  a. *Stenoplax*, Carp.
  b. *Stenoradsia*, Carp.
  c. *Ischnoplax*, Carp.
  d. *Heterozona*, Carp.
  e. *Ischnochiton*, Carp., s.s.
  f. *Ischnoradsia*, Shuttleworth.
  g. *Lepidopleurus*, Carp.
  h. *Lepidoradsia*, Carp.
Callistochiton, Carp.

***With girdle-pores.*

Callistoplax, Carp.
Angasia, Carp.
Newcombia, Carp.
Ceratozona, Dall.
Pallochiton, Dall.

C.—Lophyroidea.

Insertion plates broad, pectinated, projecting backward.

Chiton, Linné.
  a. *Radsia*, Gray.
Tonicia, Gray.
  a. *Fannettia*, Dall.
Eudoxochiton, Shuttleworth.
Craspedochiton, Shuttleworth.

D.—Acanthoidea.

Insertion plates thrown forward.

**Plates broad, pectinated (Acanthoidea lophyroidea).*

Sclerochiton, Carp.

***Plates sharp, grooved outside (Acanthoidea typica).*

Acanthopleura, Guilding.
- a. *Lucilina*, Dall.
- b. *Corephium*, Gray.
- c. *Francisia*, Carp.

****Plates sharp, smooth (Acanthoidea ischnoidea).*

Dinoplax, Carp.
Middendorffia, Carp.
- a. *Beanella*, Dall.

Nuttallina, Carp.
Arthuria, Carp.
Phacellopleura, Guilding.

Section II.—CHITONES IRREGULARES.

Tail plate abnormal, or with a sinus behind.

E.—Schizoidea.

Tail valve fissured.

Lorica, H. and A. Adams.
- a. *Aulacochiton* (Shuttleworth), Carp.

Schizochiton, Gray.

F.—Placiphoroidea.

Tail valve unslit, internally ridged, mucro nearly terminal.

Enoplochiton, Gray.
Ornithochiton, Gray.

Placiphora, Gray.
- a. *Fremblya*, H. Adams.
- b. *Euplaciphora*, Shuttleworth.
- c. *Guildingia*, Carp.

G.—Mopaloidea.

Tail valve with posterior sinus and one slit on each side.

Mopalia, Gray.
- a. *Placiphorella*, Carp.

Katherina, Gray.

Acanthochiton (Leach), Herrm.
- a. *Macandrellus*, Carp.
- b. *Stectoplax*, Carp.

Notoplax, H. Adams.

H.—Cryptoidea.

With double sutural laminæ.

Cryptoconchus, Blainville.

Amicula, Gray.

a. *Amicula* Dall, s.s.

b. *Chlamydochiton* Dall.

Cryptochiton, Gray and Middendorff.

I.—Chitonelloidea.

Tail plate funnel-shaped. Laminæ thrown forward.

Chitonellus, Blainville.

a. *Cryptoplax*, Gray.

Choneplax, Carp.

a. *Chitoniscus*, Carp.

DESCRIPTIONS OF GENERA AND SPECIES.

Order POLYPLACOPHORA.

Section I.—CHITONES REGULARES. Regular Chitons.

Head and tail plates of similar character.

A.—Leptoidea.

Insertion plates obsolete, or, if present, unslit.

Leptochiton.—Insertion plates absent; sinus simple, smooth, deep, not laminated; girdle with minute gravelly, smooth or striated scales; gills, short, posterior. (*Leptochiton cancellatus*, Sow.)

Deshayesiella.—Shell elongated; valves curved, pointing forwards; umbo flattened; insertion plates absent; sinus simple, broad; sutural laminæ triangular; girdle with spicules and chaffy scales. (*Deshayesiella curvatus*, A. Ad.)

Hanleyia.—Insertion plate only in anterior valve, rugose but non-denticulate; eaves minute; sinus simple, broad, shallow; girdle with hairs or fine spines, lateral tufts small. (*Hanleyia debilis*, Gray.)

Hemiarthrum.—Insertion plates only in anterior and posterior valves; smooth unslit laminæ; minute eaves; broad spongy sinus; girdle solid, downy, poriferous, lateral tufts small; gills short. (*Hemiarthrum setulosum*, Carp.)

Microplax.—Insertion plates present in all the valves; smooth unslit laminæ; no eaves; sinus obsolete; girdle, thin, horny, finely granulous. (*Microplax grayi*, Ad. and Ang.)

Genus *Leptochiton*, Gray.

"Lamina insertionis nullis; zona minutissime sabulosa; sinus lævis; haud laminatus; branchiæ breves" (Dall).

Leptochiton benthus,[1] n. sp. (Pl. I. fig. 1; Pl. II. figs. 1*a*–1*m*).

Habitat.—Station 241. June 23, 1875. Lat. 35° 41′ N., long. 157° 42′ E. 2300 fathoms. Red clay. Bottom temperature 35°·1.

Shell.—Delicate, brittle, surface with minute inconspicuous short ridges more or less radially disposed, and studded with small tubercles. The sides meet at a rounded angle of about 100°. Sutural laminæ small.

Anterior valve.—With minute scattered tubercles, which pass towards the apex into low tubercular ridges, having a concentric arrangement.

Intermediate valves.—*Central areas:* the minute surface ridges, when visible, are longitudinally disposed on the jugum, but become radial or oblique on the pleura. The tubercles are round on the jugum, but become somewhat oval on the pleura, and there appear to be concentrically arranged, although in some valves they seem to more or less regularly diverge from the apex. *Lateral areas:* the surface ridges are radial, and more pronounced than elsewhere. On the upper portion of the areas there are transverse low ridges placed further apart than the former; these ridges by being interrupted gradually pass into tubercles. The tubercles are round, distinctly smaller than in the central areas, and more scattered.

Posterior valve.—With a small central umbo. *Anterior area:* with concentric tubercles, as in the lateral areas. *Posterior area:* similar to the anterior valve.

Girdle.—Narrow, with delicate scales, which form a minute fringe at the edge.

Colour.—Greyish white, with one or two irregular reddish brown flecks.

Size.—Length, 8 mm.; breadth, 3·5 mm.

Gills.—Seven in number, extending between the prominent anus and postero-lateral angle of the foot. The gill row is one-seventh of the total length of the body, the proportion with regard to the length of the foot is 1 : 4·5. They are of moderate size, the middle being the largest, slightly decreasing behind but much more so in front.

Leptochiton belknapi, Dall (Pl. I. fig. 2; Pl. II. figs. 2*a*–2*d*).

Leptochiton belknapi, Dall, Proc. U.S. Nat. Mus., 1878, pp. 1, 317.

"L. t. elongatâ, valde elevatâ, dorsaliter angulatâ; albidâ plus minusve cinereo et nigrotinctâ; valvis elevatis, apicibus distinctis; mucrone centrali conspicuo; sculptura ut in *Leptochiton alveolo*, sed granulis in areis dorsalis sparsim et quincuncialiter dispositis.

[1] The specific name is derived from βένθος, depth, especially of the sea.

Valva posticâ sub apicè concavâ, posticè sinuatâ. *Zona* minimâ, spiculis tenuibus versus marginem munita. Lon. 10·0. Lat. 3·0 mm. Div. 90°."

"North Pacific Ocean, in lat. 53° 08′ N., lon. 171° 19′ W., at a depth of 1006 fathoms; black sand and shells. Brought up in the sounding-cup by Capt. Geo. E. Belknap, U.S.N., on the sounding expedition of U.S.S. 'Tuscarora' in 1874, bottom temperature 35°·5 F. (Specimens obtained by H.M.S. Challenger in Balfour Bay, Royal Sound, Kerguelen Id., Southern Ocean, in 20–60 fms., for examination of which I am indebted to the courtesy of Rev. R. J. Boog Watson, are apparently identical with Captain Belknap's species.)" *Loc. cit.*, p. 317.

I have quoted the last paragraph in full, as Dall refers to some Challenger specimens. I received only one minute specimen from Kerguelen Island, which will be found to differ considerably from *Leptochiton belknapi*. It is most probable that Dall refers to the two specimens from off the Philippine Islands which I have identified as *Leptochiton belknapi*.

Locality.—Station 205. November 13, 1874. Lat. 16° 42′ N., long. 119° 22′ E. Off Cape Bolinas, Luzon, Philippine Islands. 1050 fathoms. Blue mud. Bottom temperature 37°.

Shell.—Brittle, closely covered with large round smooth tubercles. The sides meet at an angle of about 110°. Sutural laminæ small.

Anterior valve.—With a few irregular lines of growth, thickly covered with irregularly disposed tubercles.

Intermediate valves.—*Central areas:* with a shallow depression on each side of the median ridge, which gives the latter a pinched appearance; this depression is most apparent at the hinder border of each valve. The tubercles have a general arrangement in oblique lines radiating forwards from the keel, and at the same time in lines concentric to the umbo, but these two series of lines are not always regular, and the tubercles often appear to be irregularly disposed. A series of short concentric rows usually demarcate the anterior border of the lateral areas. *Lateral areas:* scarcely apparent; a groove indicating a line of growth occurs at a short distance from the girdle; tubercles irregularly disposed, with a tendency, however, to concentric lines.

Posterior valve.—With a small subcentral umbo, behind which is a slight depression. *Anterior area:* the lateral longitudinal depression causes the jugum to be slightly prominent, and thus gives the anterior area a somewhat trilobed appearance; the tubercles radiate from the rounded keel. *Posterior area:* with concentric lines of growth and closely set tubercles.

Girdle.—Narrow, thickly covered with delicate small oval scales: longer, narrower, and more pointed scales occur along the border, and in the angles between the valves.

Colour.—Greyish white.

Size.—Length about 12 mm.; breadth, 5 mm.; height about 2·5 mm.

Gills.—Forming a short posterior row, six or seven in number.

This species is considerably larger and coarser than the preceding. The tubercles are twice the size, and closer together. The shell is also comparatively sharply keeled, instead of having a gently rounded appearance.

Leptochiton kerguelensis, n. sp. (Pl. I. fig. 3; Pl. II. figs. 3*a*–3*e*).

Habitat.—Station 149c. January 19, 1874. Lat. 49° 32′ S., long. 70° W. Balfour Bay, Royal Sound, Kerguelen. 60 fathoms. Volcanic mud. Bottom temperature probably 40°.

Shell.—Minute, smooth, or with scattered minute tubercles; the sides meet at an angle of about 100°; sutural laminæ small, triangular.

Anterior valve.—Small, smooth, with scattered aborted tubercles.

Intermediate valves.—*Central area* smooth, with very faint longitudinal striæ; *lateral areas* scarcely discernible, with faint radial striæ and minute concentric interrupted ridges towards the apex, which pass into inconspicuous small scattered tubercles.

Posterior valve.—With full rounded umbo, behind which is a shallow depression. *Anterior area:* similar to the central areas of the intermediate valves. *Posterior area:* similar to the anterior valve.

Girdle.—Narrow, with delicate scales.

Colour.—Uniform whitish.

Size.—Length, 3 mm.; breadth, 1·5 mm.

Gills.—Posterior, eight or nine in number.

Leptochiton alveolus (M. Sars, MS.)

Chiton alveolus (M. Sars, MS.), Lovén, Ind. Moll. Lit. Scand. Occ., 1846, p. 159.
Lepidopleurus alveolus, G. O. Sars, Moll. Reg. Arct. Norvegiæ, 1878, p. 110, pl. vii. figs. 3a–i, pl. I. fig. 7.
Leptochiton alveolus, Dall, Proc. U.S. Nat. Mus., 1878, p. 317.

"Corpus colore nunc pallidiore, albido-cinereo, nunc obscuriore, interdum fere omnino nigro, forma quam solito angustiore, elongato-oblongum, plus duplo longius quam latius, zona perangusta, squamulis inæqualibus, nonnullis spinæformibus.

"Testa sat convexa, dorso æqualiter arcuato ne vestigium quidem carinæ vel arearum lateralium præbente, valvulis sat elongatis, postica antica majore, semiorbiculari, antice ad lineam rectam truncata, mediis subæqualibus, margine postico recto, antico medio leviter emarginato. Superficies valvularum tuberculis minutis ovatis regulariter dispositis ubique sculpta. Long. 16 mm."—(G. O. Sars.)

Habitat.—West coast of Norway, Hardangerfjord, 420 fathoms; between Lofoten and Bodö, 150 to 300 fathoms (Sars); Gulf of St Lawrence, in 220 fathoms, between Cape Rosier and the south-west point of Anticosti Island (Whiteaves); St George's Bank, Gulf of Maine, 150 fathoms, U.S. Fish Commission, 1872 (Dall).

I have introduced this species for the sake of comparison with the foregoing, as they are undoubtedly allied forms. There are several other species of *Leptochiton* which it is unnecessary to refer to here.

The following table has been drawn up to facilitate a comparison between the foregoing species :—

	Angle of Shell.	Lateral Areas.
1. *Leptochiton alveolus* (Sars) . . .	Almost semicircular	Obsolete
2. „ *belknapi*, Dall . . .	Angular, 90°	Raised, concentrically rugose
3. „ „ (Challenger)	Angular, with a lateral depression, 110°	Scarcely apparent
4. „ *benthus*, n. sp. . .	Rounded angle, 100°	Slightly raised, rugose in upper portion
5. „ *kerguelensis*, n. sp. .	Angular, 100°	Scarcely apparent

	Surface of Shell.	Arrangement of Tubercles.			
			Jugum.	Pleura.	Lateral Areas.
1.	Smooth (?)	Close	Even, in no pattern.		
2.	„ (?)	More widely	Quincunx	In series (?)	Irregular
3.	Smooth	Close	Fairly regular	In series	Irregular
4.	Striated	More widely and rather small	Irregular	Irregular	Smaller size, and more distant
5.	„	...	None	None	Minute and scattered

From this table it will be seen that the first three species belong to the same group of forms. Dall hesitated about separating his species from *Leptochiton alveolus*, and he, Boog Watson, and myself, at first referred the two latter to the same species; and it is only after repeated and careful scrutiny that I have finally decided to consider them as distinct.

We are still in the analytical stage with regard to this group, and it is perhaps advisable, at all events for the present, rather to emphasise any distinctions, and with this intent I have described my specimens with as much minuteness as possible. Unfortunately Dall has given us no figure of *Leptochiton belknapi*, but I have little doubt that the Challenger specimens from the Philippines are examples, or, at most, varieties of that species.

Genus *Hemiarthrum*, Carpenter, MS.

Hemiarthrum, Carpenter M.S., Dall, Bull. U.S. Nat. Mus., 1876, vol. iii. p. 44.

"Valvæ terminales laminatæ, haud articulatæ; laminæ laterales obsoletæ; zona lanuginosa, porifera; branchiæ posticæ."

Hemiarthrum setulosum, Carpenter MS. (Pl. I. fig. 4; Pl. II. figs. 4*a*–4*l*).

Hemiarthrum setulosum (Carpenter MS.), Dall, Bull. U.S. Nat. Mus., 1876, vol. iii. p. 44.
„ „ Dall, Proc. U.S. Nat. Mus., 1878, p. 314.

Habitat.—January 20, 1874. Royal Sound, Kerguelen Island. Shore. Kerguelen Island, on stones at low water (Dr Kidder).

"H. t. latiore, curvata, olivaceo-fusca; jugo planato; mucrone subcentrali? areis haud definitis; totâ superficie sensim quincunxiter granulosâ, granis satis extantibus.

"*Intus;* valva anticâ et posticâ conspicue laminata; laminis acutis, haud incisis, haud regularibus, valde extantibus; subgrundis spongiosis, minimis; valvis centralibus et posticâ laminis suturalibus, triangularibus, maxime distantibus, extantibus, decliviter, lateraliter, continuis; sinu maximo, valde spongioso.

Zona modicâ, haud expansâ, solida, leve; sparsim minutissime lanuginatâ; poris minutissimis, setuliferis ad suturas, et circ. iv. circumvalvas terminales sitis, instructâ, setulis minimis, curtissimis.

Animal, pede capiteque normalibus; branchiis majoribus posticis, utroque latere circiter vi., medio pede tenus. *Lon.* 13 mm. *Lat.* 7 mm. *Div.* variante ad 130.°"

The above description was written by Carpenter from two specimens shortly before his death, and incorporated by Dall in his report on the Mollusca collected by Dr Kidder at Kerguelen Island, who accompanied the United States Transit of Venus Expedition, 1874–75.

The colour of the shell, in the single specimen collected by the Challenger Expedition, is of a uniform warm dark brown, and the girdle is chestnut brown, with a pale crenulated border round the margin of the valves. In each of the dark triangular bays between the valves is a small tuft of short white spicular scales, and there are six similar tufts round the anterior border of the first valve.

The *anterior* and *posterior valves* and the lateral areas of the intermediate valves are marked by concentric lines of growth, otherwise the latter are scarcely discernible. The jugum is very gently rounded, so that the pleura are slightly depressed. The unslit insertion plate of the anterior and posterior valves is shown in Pl. ii. figs. 4*a*, 4*f*.

The *girdle* is thick and soft, with a few minute scattered scales. There is a distinct fringe of reddish brown elongated striated scales round the margin. The scales forming the tufts are stout, and white in colour. Carpenter describes the anterior tufts as *about* four in number; in my specimen there are *six* anterior tufts. Evidently Carpenter was not quite satisfied on this point, as in all other Chitons which possess tufts, only four are present; and, consequently, that number might be expected to occur in this species also.

The *head lappets* are rather large, and the anus is on a large rounded papilla. The longitudinal band on the under side of the girdle (veil of Carpenter) is produced into flaps at the posterior extremity.

The *gills* form a short posterior row, and appear to be about six in number; they decrease in size anteriorly.

Length 9 mm.; breadth 4 mm.; sides of valves meet at an angle of about 115°.

B. — Ischnoidea.

Callochiton, Gray.

Callochiton platessa (Gould).

Chiton platessa, Gould, Proc. Boston Soc. Nat. Hist., 1846, vol. ii. p. 143; U.S. Explor. Exped., (Wilkes), 1852, vol. xii. p. 320.
„ *crocinus*, Reeve, Conch. Icon., 1847, pl. xxii. fig. 146.
Leptochiton versicolor, A. Adams, Proc. Zool. Soc. Lond., 1852, p. 92, pl. xvi. fig. 5.
Lepidopleura platessa, Gould, Otia (Rectifications), 1862, p. 242.
Leptochiton versicolor, Angas, Proc. Zool. Soc. Lond., 1867, p. 223.

Habitat.—Port Jackson. 6 to 15 fathoms.

Australia (Gould and British Museum); Botany Bay (Angas); New Zealand (British Museum).

The tablets in the British Museum testify to Carpenter's acceptance of the above synonymy.

Shell.—Smooth, entire surface delicately shagreened, terminal valves and lateral areas only with indistinct concentric lines of growth; lateral areas not prominent, with no radial markings; umbones small, pointed.

Girdle.—With delicate flat elongated scales.

Gills.—Extend along whole length of foot, about thirty in number on each side.

Colour.—Central areas yellowish, obscurely mottled with orange; on some valves there are a central and a lateral pair of pale lines. Lateral areas and terminal valves of a uniform dull orange colour, and uniformly spotted with minute black dots, which are absent from the central areas, the posterior border of the valves is ornamented with alternate lighter and darker spots. Ligament brownish, with a few irregular small white flecks and five large white spots, four very large spots extending from the points of junction of the first and second, and seventh and eighth valves respectively, to the edge of the girdle; the fifth spot being in the median line posteriorly.

Adams' description agrees, on the whole, very well with the single specimen collected by the Expedition, but the coloration of his figure is not at all similar, with the exception of the very characteristic five white spots on the girdle.

Angas describes his specimens as being variegated with maroon and olive.

Ischnochiton, s.s. Carpenter.

Ischnochiton boogii, n.n.

Chiton roseus, Sowerby (not of Blainville), Proc. Zool. Soc. Lond., 1832, p. 58; Conch. Illustr., 1841, p. 5, No. 59, pl. xxxix. fig. 14.
„ „ Reeve, Conch. Icon., 1847, pl. xxv. fig. 119.

Habitat.—Station 113A. September 2, 1873. Fernando-Noronha anchorage. 7 to 25 fathoms.

Island of Plata, West Columbia; found on dead shells in 17 fathoms (Cuming; Sowerby).

The name *Chiton roseus* having been preoccupied by Blainville (Dict. des Sci. Nat., 1825, vol. xxxvi. p. 553), Sowerby's name cannot stand. The fact that Blainville's species is an *Acanthochiton*, while that of Sowerby is an *Ischnochiton*, does not affect the question, since they were both described as *Chiton roseus*. I have therefore re-named this species *Ischnochiton boogii*, as the specific names of *Sowerbianus*, Reeve, and *Watsonii*, Sowerby, are also preoccupied.

The locality attributed, on the authority of Cuming, to this species, made the identification with it of a Chiton from Fernando-Noronha very doubtful. A shallow-water species was not likely to live in both the Atlantic off Brazil and in the Pacific off West Columbia, with the whole breadth of South America between. That the Challenger specimen is identical with the British Museum specimens is beyond doubt. May not the difficulty find solution in the fact that the "I. of Plata," as it stands on Cuming's tablet in the British Museum, and to which Sowerby (*loc. cit.*) added "W. Columbia," is really some island in the estuary of La Plata?

The above criticism was first suggested to me by the Rev. R. Boog Watson, to whom it gives me great pleasure to dedicate this species.

The single specimen in the collection is of a pink colour mottled with creamy yellow, with an obscure yellow line along the jugum, and with a pale spot on each side of the line on several valves; there are also several irregular dark patches; the posterior valve is deep-rose below the umbo. The girdle is mottled brown and white, there being a white patch at the junction of each valve.

The shell is long, narrow, and arched, anterior and posterior valves with fine concentric ridges; the umbo of the latter is prominent. The intermediate valves are apparently smooth, but really with extremely delicate longitudinal striæ; the lateral areas are characterised by wide ridges. The ligament has stout, tall, imbricate scales.

The three specimens of this species in the British Museum are pink and only slightly flecked with white, no black or brown spots, and in two of them the central areas have concentric lines like those of the lateral areas.

Ischnochiton viridulus (Couthouy).

Chiton viridulus, Couthouy MS. (Gould), Proc. Boston Soc. Nat. Hist., 1846, vol. ii. p. 144; Wilkes, U.S. Explor. Exped., 1852, vol. xii. p. 318; Otia, 1862, p. 5.

Habitat.—Cape Town.
Orange Harbour, Cape of Good Hope.

Shell.—Of the single specimen uniformly covered with minute low tubercles, which are horizontally disposed on the pleura; lateral areas scarcely distinguishable; the peri-

pheral portion of the terminal valves and lateral areas is marked by slight concentric lines of growth.

Colour.—White, with a few irregular dark flecks on the sides.

Girdle.—With delicate, imbricate, coarsely striated scales.

Specimens in the Zoological Museum of the University of Cambridge are very similar, they are of a creamy-yellow colour, very slightly tinged with green, the lateral areas are moderately elevated.

Ischnochiton longicymba (Blainville).

Chiton longicymba, Blainville, Dict. des Sci. Nat., 1825, vol. xxxvi. p. 542; Quoy and Gaimard, Voyage de l'Astrolabe, Zool., 1834, vol. iii. p. 390, Atlas, pl. lxxiv. figs. 1–18; Deshayes in Lamarck's Hist. Nat. Anim. s. vert., 1836, vol. vii. p. 512; Sowerby, Conch. Illustr., 1841, No. 45, pl. clx. fig. 67 (vars.); Reeve, Conch. Icon., 1847, pl. xxiv. fig. 163.

Lepidopleurus longicymba, Angas, Proc. Zool. Soc. Lond., 1865, p. 187, and 1867, p. 222.

Ischnochiton longicymba, Dall, Proc. U.S. Nat. Mus., 1878, pp. 78, 113.

Habitat.—Port Jackson. 6 to 15 fathoms.

Australia and New Zealand.

I have identified as this species three specimens obtained by the Expedition from Port Jackson. The shell is elongated, having a rounded angle, and with the lateral areas but slightly raised. The whole of the central areas are delicately shagreened; the lateral areas and terminal valves with very fine interrupted and often bifurcated ridges. The whole shell has a decidedly smooth appearance. One specimen is of a pale creamy green colour and another pale pink, both with a few dark spots on the central areas; the third is white, with a black band all round the edge, and with usually paired black marks on several of the valves on each side of the jugum, resembling in some respects Quoy and Gaimard's fig. 14. The girdle is indistinctly banded.

Ischnochiton fruticosus (Gould).

Chiton fruticosus, Gould, Proc. Boston Soc. Nat. Hist., 1846, vol. ii. p. 142; U.S. Explor. Exped. (Wilkes), 1852, vol. xii. p. 319; Otia, 1862, p. 4, and Rectifications, p. 242.

„ *divergens*, Reeve, Conch. Icon., 1847, pl. viii. fig. 44.

Lepidopleurus proteus (?), Angas (? of Reeve), Proc. Zool. Soc. Lond., 1867, p. 222.

Habitat.—Port Jackson. 6 to 15 fathoms.

New South Wales (Gould); New Holland (Jukes-Reeve); Port Jackson (Angas).

This is a very variable form, not only in colour but also in sculpture. In order to define the limits of this and allied species a large number of specimens is necessary. The following species form a series, appearing to pass more or less into each other, or at all events to be closely allied :—*Ischnochiton longicymba*, Blainville; *Ischnochiton fruticosus*,

Gould; *Ischnochiton divergens*, Reeve; *Lepidopleurus proteus*, Reeve; *Lepidopleurus ustulatus*, Reeve. The first has the central areas uniformly shagreened, and the lateral areas with fine ridges. The remaining forms have the jugum of the central areas shagreened and the pleura finely ribbed, the lateral areas being distinct and having coarse, interrupted, and irregular ridges. The extreme of this style of sculpture is reached in *Callistochiton antiquus*, Reeve, with its strong pleural ridges and secondary cross ridges on the central areas, and the two prominent coarsely rugose ridges on the lateral areas.

The colour of the half-dozen specimens is greyish, yellowish, or rusty, mottled and passing into a deeper colour at the edge, forming a distinct brownish, greenish, or orange border to the shell; median dorsal line with a series of dark spots. Ligament more or less banded.

Lepidopleurus, Carpenter.

Lepidopleurus dorsuosus, n. sp. (Pl. I. fig. 5, Pl. III. figs. 5*a*–5*i*).

Station 145A. December 27, 1873. Lat. 46° 41′ S., long. 38° 10′ W. Prince Edward's Island. 310 fathoms. Volcanic sand.

Shell.—Remarkably compressed laterally, the two sides meeting at an angle of 75°.

Anterior valve.—Concentrically rugose, with about twenty-six radiating low irregular ridges, some of which bifurcate.

Intermediate valves.—*Central area:* with jugum and anterior border striated, the pleura with distinct horizontal ridges. *Lateral areas:* distinct, concentrically rugose, usually with three main radiating low ridges, the anterior and posterior of which are often bifid.

Posterior valve.—Concentrically rugose, with fifteen irregularly arranged low radiating ridges. The anterior ridge is broader than the others, and may be slightly bifid. Umbo rudimentary; anterior border smooth, with slight concentric lines of growth. Laminæ of insertion moderate in size.

Girdle.—Narrow. Upper surface with ovoid, slightly overlapping, somewhat granular scales; edge with minute projecting spicules under surface, with long, narrow, closely applied scales.

Colour.—White.

Size.—Length, 21·5 mm.; breadth, 7·5 mm.; height, 6 mm.

Gills.—Extending to more than half the length of the foot, twenty in number, the middle somewhat larger than the remainder.

The name *dorsuosus*, full of ridges, is applicable to this species on account of its numerous longitudinal and radiating ridges, and at the same time recalling the steep ridge of the shell itself.

Lepidopleurus dallii, n. sp. (Pl. I. fig. 6, Pl. III. figs. 6*a*–6*i*).

Habitat.—Station 310. January 10, 1876. Lat. 51° 27′ 30″ S., long. 74° 3′ W. 400 fathoms. Blue mud. Bottom temperature 46°·5.

Shell.—Evenly covered with closely set minute low tubercles, which give it a granular appearance, with straight sides meeting at an angle of 110°.

Anterior valve.—Coarsely granular, with twenty-six short radial rows of tubercles, each row consisting of four or five tubercles, which diminish in size from the periphery towards the apex; the posterior row is the broadest, and is partially bifid.

Intermediate valves.—*Central area:* jugum, coarsely granular; pleura, with about twelve or thirteen distinct horizontal ridges. *Lateral areas:* granular, with three main radiating rows of tubercles, the anterior and posterior often partially double.

Posterior valve.—Remarkably flat, coarsely granular, with nineteen rows of three tubercles each, of which the outermost is the largest. Umbo scarcely, if at all, raised above the surface. Anterior border coarsely granular, with the granules passing into oblique ridges on the pleura.

Girdle.—Medium breadth, upper surface with smooth imbricating scales in oblique rows, about seven or eight in a row, those nearest the shell being the smallest.

Colour.—Greyish white.

Size.—Length, 11 mm.; breadth, 6 mm.; height, about 3 mm.

Gills.—Extending to about three-quarters the length of the foot, diverging posteriorly and hidden by a slight swelling of the longitudinal band on the under surface of the girdle; about twenty-one in number, largest about the fifth from the posterior end, and gradually diminishing in size anteriorly.

I have associated this species with the name of my friend Mr W. H. Dall, of the Smithsonian Institution, Washington, U.S.A.

Lepidoradsia, Carpenter.

Lepidoradsia australis (Sowerby).

Chiton australis, Sowerby, Mag. Nat. Hist., 1840, p. 290, and Conch. Illust., 1841, p. 2, No. 19, pl. cxxxix. fig. 46.
„ *evanidus*, Sowerby, Conch. Illust., 1841, p. 3, No. 38, fig. 139.
„ *australis*, Reeve, Conch. Icon., 1847, pl. ii. fig. 10.
Lophyrus australis, Angas, Proc. Zool. Soc. Lond., 1867, p. 221.
Lepidoradsia australis, Dall, Proc. U.S. Nat. Mus., 1878, pp. 79, 113, 115.

Habitat.—Port Jackson. 6 to 15 fathoms.

Australia, Raine Island, Torres Strait (Cuming); Port Jackson, "common under stones" (Angas).

The collection includes several specimens of this common and well-known form.

Callistochiton, Carpenter.

Callistochiton antiquus (Reeve).

Chiton antiquus, Reeve, Conch. Icon., 1847, pl. xxv. fig. 169.
Lepidopleurus antiquus, Angas, Proc. Zool. Soc. Lond., 1867, p. 223.
Callistochiton antiquus, Carpenter MS.

Habitat.—Port Jackson. 6 to 15 fathoms.

Port Jackson and Newcastle, New South Wales (Dr Dieffenbach in British Museum).

This species closely resembles *Callistochiton elenensis*, Sow. (Proc. Zool. Soc. Lond., 1832, p. 27, and Conch. Illust., No. 79, pl. clxii. fig. 69), from St Elena, West Columbia, and Panama. Angas considers them synonymous, but he retains Reeve's name. *Callistochiton elenensis*, however, closely resembles *Callistochiton decoratus*, Carp., from California, if indeed it be really distinct. The most pronounced sculpture occurs in *Callistochiton palmulatus*, Carp., also from California.

Mr E. A. Smith has described[1] *Callistochiton coppingeri*, a form closely allied to the above, but apparently sufficiently distinct from it, which also comes from Port Jackson.

C.—Lophyroidea.

Genus *Chiton*, Linné.

Chiton squamosus, Linné.

Chiton squamosus, Linné, Syst. Nat., 1767 (ed. 12), p. 1107; Deshayes, Lamarck's Hist. Nat. Anim. s. vert. (ed. 2), 1836, vol. vii. p. 490; Sowerby, Conch. Illust., 1841, p. 2, No. 13, pl. clxii. fig. 76 (var.); Gray, Proc. Zool. Soc. Lond., 1847, p. 66, and Guide to Moll., 1857, p. 180; Reeve, Conch. Icon., 1847, pl. iii. fig. 16, pl. iv. fig. 23 (var.); Tristram, Proc. Zool. Soc. Lond., 1861, p. 403.
„ *assimilis*, Reeve, Conch. Icon., 1847, pl. xiv. fig. 77, a and b.

Habitat.—Station 36. April 22, 1873. Bermudas. Lat. 32° 7′ 25″ N., long. 65° 4′ W. 30 fathoms. Coral. Two specimens.

West Indies.

Although there is some doubt concerning several of Linné's species of Chitons, conchologists are now quite agreed as to which form they accept as *Chiton squamosus*, Linn., and it is usually regarded as the type-species of the genus as commonly restricted. The brothers Adams selected *Chiton aculeatus*, Linn., as the type of the genus *Chiton* as restricted by them, and they have been followed by other naturalists in this and in the use of the generic name *Lophyrus* for those Chitons with large, smooth, imbricated scales. Dall has discussed this question in his paper On the Scientific Results of the Exploration of Alaska,[2] and he agrees with Carpenter in taking *Chiton tuberculatus*, Linné, as the type of the restricted genus Chiton. Concerning this latter species Dall says: "It is

[1] Zool. Collect. H.M.S. "Alert," 1884, p. 80.

[2] *Proc. U.S. Nat. Mus.*, 1878, p. 300.

figured by Reeve as *C. squamosus*, L., var. *β*. (Conch. Ic., pl. iv. f. 23), . . . It has not been generally united with the *C. squamosus* of L. (S. N., ed. xii.), but is not improbably a variety of it, and belongs to the same restricted group."[1]

There does not seem to be a sufficient distinction between this species and *Chiton assimilis*, Reeve, to keep them apart.

The earlier bibliography of this species will be found in Gmelin's edition of Linné (1791, p. 3203), and in Deshayes' edition of Lamarck (*loc. cit.*, pp. 490, 491).

Chiton murrayi, n. sp. (Pl. I. fig. 7, Pl. III. figs. 7*a*–7*e*).

Habitat.—Valparaiso. Shore.

Shell.—Apparently smooth, but really very closely and finely striated, the striæ being roughened or interrupted; greatly depressed.

Anterior valve.—With radial striæ; under surface with eleven distinct square slits, radial grooves distinct and perforated; teeth of insertion plate serrate.

Intermediate valves.—Narrow, flattened, non-carinate, with sharp depressed umbo, surface striæ longitudinal in central areas, radial in the lateral areas; lateral areas distinct, with slight concentric rugæ, and with three or four scarcely apparent peripheral radial ridges, which die away towards the apex; sutural laminæ shallow, a single lateral slit, lateral insertion plates serrate; jugum with nine rounded teeth, the central being very small.

Posterior valve.—Flattened, slightly umbonate, striæ longitudinal on the anterior area, radial on the posterior area; under surface with seventeen distinct slits, teeth serrate; jugum finely toothed.

Colour.—Upper surface ground colour of shell a greenish grey, slightly clouded with dark brown and black; umbones lighter; on each side of the latter the ground is yellowish; whole surface sprinkled with pale blue spots, which are bounded externally by a black line; on the central areas the spots run in irregular, oblique, backwardly diverging lines, and have a slight tendency to confluence, but on the lateral areas and terminal valves the spots are irregularly scattered; under surface, pale sea-green, darker along the jugum, and with a dark spot at the umbones of the terminal valves.

Girdle.—Upper surface with large imbricate scales, of which the exposed portion is smooth, the hidden portion being usually finely striated longitudinally; colour, dark green, with a tendency to form darker bands opposite the valves; in the angles between the valves a few of the scales are paler and yellowish in colour; under surface with long narrow oblong white scales arranged in transverse series.

Gills.—Extending along the whole length of the foot, about fifty-five or sixty in number.

Size.—Length, 12·5 mm.; breadth, 7·5 mm.

[1] *Proc. U.S. Nat. Mus.*, p. 300.

The following Chitons also have blue spots: *Chiton magnificus*, Desh., and *Chiton disjunctus*, Fremb. The latter is also from Valparaiso, but it would be impossible to mistake these for *Chiton murrayi*.

Superficially, this species bears some resemblance to *Lepidopleurus lentiginosus*, Sow. (G. B. Sowerby, 1840, Charlesworth's N. S. Loudon's Mag. Nat. Hist., and Conch. Illust., 1841, figs. 120, 121; Reeve, Conch. Icon., 1847, pl. xxiv. fig. 165=*Chiton cyaneopunctatus*, Krauss, Die südafrikanischen Moll., 1848, pl. iii. fig. 2); but apart from the generic distinctions, Sowerby's species can be distinguished by the perfectly smooth shell, inconspicuous lateral areas, paler colour of the shell generally, and absence of the external black border to the blue spots. I have given myself the pleasure of dedicating this pretty and distinctive little Chiton to Mr John Murray of the Challenger Expedition.

Chiton nigrovirescens, Blainville.

Chiton nigrovirescens, Blainville, Dict. des Sci. Nat., 1825, vol. xxxvi. p. 538.
„ *capensis*, Gray, Spicilegia Zool., 1828, p. 5.
„ „ Wood, Index Test. Suppl., 1828.
„ „ Reeve, Conch. Icon., 1847, pl. xxii. No. 151.
„ „ Krauss, Südafrik. Moll., 1848, p. 37, No. 5.

Habitat.—Sea-point, near Cape Town. Shore.

Cape of Good Hope.

Half-a-dozen specimens of this pretty little Chiton were collected. Blainville's description is not very good, but it is sufficiently exact to justify the retention of his name.

Chiton pellis-serpentis, Quoy and Gaimard.

Chiton pelliserpentis, Quoy and Gaimard, Voyage de l'Astrolabe, 1834, vol. iii. p. 381, pl. lxxiv. figs. 17–22.
„ „ Deshayes, Lamarck, Hist. Nat. Anim. s. vert., 1836 (ed. 2), vol. vii. p. 508.
„ *pellis-serpentis*, Reeve, Conch. Icon., 1847, pl. xv. fig. 84.
„ „ Hutton, Cat. Mar. Moll. of N. Z., 1873, p. 46, No. 217, and Manual New Zeal. Moll., 1880, p. 111.
„ „ v. Martens, Crit. List., 1873, p. 36.

Habitat.—Durville Island, New Zealand. Beach.

New Zealand.

This species is stated to be extremely common in New Zealand, but the Expedition only brought back a single specimen.

Chiton jugosus, Gould.

Chiton jugosus, Gould, Proc. Boston Soc. Nat. Hist., 1846, vol. ii. p. 142.
„ „ Gould, Wilkes' Explor. Exped. Mollusca, 1852, vol. xii. p. 317, pl. xxviii. fig. 430.
Lophyrus jugosus, Gould, Otia Conch., 1862, pp. 3, 242.
„ *concentricus*, Reeve, Conch. Icon., 1847, pl. xvi. No. 95.

Lophyrus concentricus, Angas, Proc. Zool. Soc. Lond., 1867, p. 221, No. 228.
„ *jugosus*, Angas, Proc. Zool. Soc. Lond., 1867, p. 222, No. 231.
Chiton jugosus, E. A. Smith, Rep. Zool. Collect. "Alert," 1884, p. 78.

Port Jackson, Sydney. 6 to 15 fathoms.

This species was independently described by Gould and Reeve about the same time. Angas distinguishes *Chiton jugosus* as having the terminal valves smooth, whereas they are concentrically grooved in *Chiton concentricus*, but this distinction does not appear to be of sufficient importance to separate the two forms. The two Challenger specimens have the terminal valves smooth, or, at most, with lines of growth, but the concentric lines on the valves are very deceptive. Angas found specimens of the latter at Watson's Bay with "the second valve sometimes blood-colour or scarlet;" one of the Challenger specimens has this peculiarity. The specimens Angas identified as *Lophyrus jugosus*, with smooth terminal valves, occurred at Camp Cove. Both were found at very low tides.

All the localities are from New South Wales, as Smith says, "Confirmation of the New Zealand locality (Reeve) of this species is still wanting."

D.—Acanthoidea.

Genus *Acanthopleura* (restricted by Carpenter), Guilding.

Acanthopleura spiniger (Sowerby).

Chiton aculeatus, Quoy and Gaimard (not of Gmelin?), Voyage de l'Astrolabe, Zool., 1834, vol. iii. p. 373; Atlas, pl. lxxiv. figs. 1–5.
„ *spiniger*, Sowerby, Conch. Illust., 1841, p. 1, pl. clxi. fig. 68.
„ „ Reeve, Conch. Icon., 1847, pl. xiv. fig. 75.
Maugeria spinigera, Gray, Guide Moll. Brit. Mus., 1857, p. 184.
Acanthopleura spinigera, Dall, Proc. U.S. Nat. Mus., 1882, vol. i. p. 80.
„ *spiniger*, E. A. Smith, Zool. Collect. H.M.S. "Alert," 1884, p. 81.
Chiton granatus,[1] Reeve, Conch. Icon., 1847, pl. v. fig. 24 (Mus. Cum.).
„ *macgillivrayi*,[1] A. Adams, Proc. Zool. Soc. Lond., 1855, p. 120.
Maugeria owenii,[1] Gray, Guide Moll. Brit. Mus., 1857, p. 184.
Acanthopleura glareosa,[1] Carpenter MSS. in Mus. Cum. (Brit. Mus.)
Chiton borbonicus (?),[1] Deshayes, Moll. de Réunion, 1863, p. 37, pl. v. figs. 12, 13.
„ *piceus* (?),[1] Reeve (*non* Gmelin), Conch. Icon., 1847, pl. xiii. fig. 70.
= „ *obesus*,[1] Shuttleworth, Bern Mittheil., 1853, p. 79.
„ *cunninghamii* (?),[1] Reeve, Conch. Icon., 1847, pl. xxvii. fig. 181 (Mus. Cum.).

Habitat.—Station 187. September 9, 1874. Lat. 10° 36′ S., long. 141° 55′ E. Albany Island, Cape York, North Australia. 6 fathoms. Coral mud.

Philippine Islands (Cuming); New Guinea, New Ireland (Quoy and Gaimard); Port Essington (Jukes); Port Molle and Clairemont and Bird Island (Coppinger); New Zealand and Tongatabou, Friendly Islands (Quoy and Gaimard); Fiji (for *Acanthopleura macgillivrayi*); New Zealand (for *Acanthopleura glareosa*).

[1] These synonyms are given on the authority of Mr E. A. Smith, *loc. cit.*

The single specimen is very much worn, but the shell appears to possess concentric lines of growth furnished with minute black tubercles; along the jugum these are either absent or worn away; lateral areas scarcely defined. Ground colour buff, dark at the sides, and streaky on each side of the pale jugum.

The *girdle* is covered with a close covering of very short mixed black and white spines, in which a banded arrangement can be discerned, a darker band corresponding to each valve; there are also numerous large stout blunt spines, which are usually white in colour, but may be black tipped with white.

In a specimen from New Ireland in the Science and Art Museum, Dublin, there is a similar banded arrangement of very small spicules, but the larger ones are of considerable size, being 3 mm. in length, arcuate, and white in colour. The animal itself is 65 mm. in length, and 35 mm. in breadth.

The *Chiton aculeatus* of Quoy and Gaimard is clearly this species. The authors describe two varieties, the one (A.) with short obtuse, closely set spines, and ligament with eight black bands; the other (B.) with long sharp scattered green spines. The anterior valve with nine to twelve (var. A.) striated teeth, the posterior with eight. The under surface of the valves with a brown jugum; the remainder is horn-coloured, with a "burnt spot" (*tache brûlée*) at the angle of the apophyses. Length 4 inches 6 lines, breadth 2 inches, but there are larger. This species is found in New Zealand, New Guinea, and New Ireland. Var. A. is from Tongatabou and Port Dorey, New Guinea. The var. B., which evidently is the same species as that mentioned above from New Ireland, appears to be a well-marked form.

In his MSS. Carpenter states that "*Acanthopleura granata*, Reeve (no locality), is a worn specimen of *Acanthopleura borbonica*, Desh.; and *Acanthopleura macgillivrayi*, A. Ad. (no locality), is perhaps only a fine *Acanthopleura piceus*, Reeve, *Acanthopleura borbonica*, Desh., &c., and very close to *Acanthopleura brevispinosa*, Sow."

I am indebted to my friend, the Rev. H. M. Gwatkin of Cambridge, for a couple of specimens of *Acanthopleura* sp. (?) from Aden in the Red Sea, which undoubtedly belong to the *Acanthopleura spiniger* series. The shell is much more delicate than in the other species of the genus with which I am acquainted. The surface is evenly studded with very small concentrically disposed black tubercles; the colour appears to be a uniform dark brown or black; lateral areas obsolete. The under surface of the valves has some points of interest. There are ten slits in the anterior valve, long teeth, short eaves, the colour is brown, the jugum being of a darker colour. The intermediate valves are greyish, or brownish grey behind, the jugum dark brown in colour, and the sutural laminæ are grey, tinged with madder brown. The posterior border is less peaked than in *Acanthopleura spiniger* (type), and consequently the reflected portion of the tegmentum encroaches less on the under surface; in this respect and in the general appearance of the under surface the intermediate valves somewhat resemble those of *Acanthopleura granu-*

lata from the Barbadoes. The posterior valve has nine or ten slits, long teeth, short eaves; in colour and general appearance it resembles *Acanthopleura spiniger*, except that the shell is very much thinner, the insertion plates whiter, and the jugum, as in the other valves, of a deeper and madder-coloured brown, instead of the nearly uniform slaty brown which characterises what I consider to be the typical species. The striation in all the teeth is also more delicate.

The *girdle* is very closely beset with fairly long, but thin calcareous spines, which are black, with white tips, and in my specimens present no banded arrangement.

Acanthopleura (?) *incana* (Gould).

Chiton incanus, Gould, Proc. Boston Soc. Nat. Hist., 1846, vol. ii. p. 145, and Wilkes' Explor. Exped., 1852, p. 315, pl. xxviii. figs. 432, 432a; also Otia, p. 6.
Maugeria incanus, Gould, Otia, 1862, p. 248.
Acanthopleura incana, E. A. Smith, Zool. Collect. H.M.S. "Alert," 1884, p. 81.
Chiton piceus (?), Angas (not of Gmelin), Proc. Zool. Soc. Lond., 1867, p. 223.

Habitat.—Oosima, Japan. Specimen B.
Port Jackson. 6 fathoms. Specimen C.
New South Wales (Gould); Port Jackson (Coppinger); Stewart Island, New Zealand (C. Traill in British Museum).

The shell in the specimens from Japan is very finely tubercular, with concentric lines of growth; the lateral areas are scarcely apparent; dark brown in colour, with a pale line on each side of the jugum.

The girdle spines in the Japanese specimen (B.) are mostly dark brown in colour tipped with pale brown or white; a few are white, and only very indistinctly suggest a banded arrangement.

A second specimen from Japan (A., given me by Mr Dall) has distinct bands for the first, second, third, and seventh valves, those for the fourth, fifth, and sixth valves are confluent, and nearly the whole of the girdle round the last valve is black.

The shell in the example from Port Jackson (C.) is sculptured with concentric waved lines, the inconspicuous lateral areas with short, very fine radial ridges; colour as above.

The girdle spines of this specimen are somewhat smaller than in the former, and are arranged in alternate black and white bands, only slightly differing on the two sides. There is a broad black band at the sides of the first and last valve, a narrow one opposite the second and third valves, a broad band extending along the fourth and fifth valves, and a narrow one between the sixth and seventh valves, making six on each side. The dark spines are also tipped with a lighter colour or with white.

In Gould's type-specimen there are ten black bands on the girdle, the anterior and posterior valves each having two pairs. The spines of the girdle are much more uniform in size than in the preceding species.

It is probable that the *Chiton piceus* of Angas is this species. He informs us that "this very common species is freely distributed on most parts of the coast of New South Wales. Dwelling in cavities on the upper surfaces of the rocks exposed to the full action of the waves, the valves are generally more or less worn and destitute of character. Length, 2½ inches."

The two foregoing species have a close external resemblance with each other and with *Acanthopleura picea* (Gmel.), auct. (non Reeve). As a matter of fact, the former has frequently been described as *Acanthopleura picea* in spite of its apparently discontinuous distribution in the West Indies and in the Indian Ocean. To Mr E. A. Smith of the British Museum belongs the credit of pointing out characters on the under surface of the valves which serve to distinguish these three species from each other.

These species can be separated on a careful comparison of the sculpture of the shell, but unfortunately the shells are almost invariably so corroded that the surface markings are obliterated. The differences in the character of the girdle are too slight to be of much value; the light and dark bands of the latter are too variable to be of any use.

The following analyses refer to two out of many specimens in my own collection of *Acanthopleura granulata* (Gmel.), from Barbadoes, in future referred to as A. and B., and to a specimen (C.) of *Acanthopleura* sp. (?) (= *Acanthopleura picea*, Gmel.) from the West Indies, probably from St Thomas, for which I am indebted to my friend Mr W. H. Dall. Also to the Challenger specimen of *Acanthopleura spiniger* from Cape York, and to three specimens of *Acanthopleura incana*. The first two, A. and B., are from Japan, the last (C.) from Port Jackson. Specimen A. was given me by Mr Dall, B. and C. were collected by the Challenger.

Unfortunately the Challenger Expedition did not obtain any specimens of this genus from the West Indies, but as the West and East Indian forms have been confused with one another, I have not hesitated to deal with them all at considerable length.

Table of Measurements in mm. of the Upper Surface (Tegmentum only) of the Isolated Valves.

	Acanthopleura granulata.				*Acanthopleura* sp. (?)		*Acanthopleura spiniger.*		*Acanthopleura incana.*					
	A.		B.		C.				A.		B.		C.	
Valves.	Length.	Brdth.	Length.	Brdth.	Length.	Brdth.	Length.	Brdth.	Length.	Brdth.	Length.	Brdth.	Length.	Brdth.
1	12	19	9	16	10	20	13·5	19	9	15·5	5	10	4	8
2	14	22·5	11	19	12	23	16	23	10·5	18·5	6	12	5·5	9
3	11	25·5	9	21	9	26	12	26	7	20	5	12·5	3	10
4	13	27·5	10·5	23	10	27·5	13·5	28	10	22	5	13	4	11
5	13	28	10	24	10·5	28	13	28	10·5	23	6	13·5	4·5	11·5
6	13·5	26·5	11	23	11	26·5	12	27	9·5	22	6	13	3·5	11
7	11	23	8·5	20·5	8·5	23	11	24	8	20	5	12·5	3·5	10
8	8	17	7·5	16	10	19	10	20	6	15·5	4·5	10	3·5	8
Total size of body	61	37	55	31	65	40	85	42	60	40	28	20	21	15

Owing to the corrosion of the umbo the measurements of the length of the valves are not absolutely accurate, and as most of the specimens are curled the total length of the body is only approximate.

From this table it will be seen that the ratios of the length to the breadth of the valves is the same in *Acanthopleura granulata*, A. and B., but the valves are relatively shorter in *Acanthopleura* sp., C.

It appears that the valves are relatively very slightly longer in *Acanthopleura spiniger* than in *Acanthopleura granulata* (A. and B.), but the ratio in *Acanthopleura incana* is as nearly as possible the same.

Analysis of Under Surface of Valves.

Anterior valve.—Acanthopleura granulata, A. and B., 13 slits; teeth long, the central as a rule green in colour, the lateral usually brownish; eaves short; colour pale slate or pearly gray, dark brown jugum. *Acanthopleura* sp., C., 12 slits; teeth short, all green in colour; eaves long; colour pale greenish gray, dark brown jugum but smaller than in former. *Acanthopleura spiniger*, 10 slits; teeth long, dusky colour; colour pale dusky brown. *Acanthopleura incana*, A., 11 slits; teeth short; eaves short; colour uniform very dark brown; B. 10 slits, darker colour; C. similar, but with pale teeth.

Intermediate valves.—Acanthopleura granulata, A. and B., colour greyish; jugum dark brown; sutural laminæ pale, more or less splashed with brown; posterior border of anterior laminæ deeply grooved. *Acanthopleura* sp., C., colour pale sea-green; jugum dark brown; sutural laminæ of uniform colour, with their posterior border very slightly striated; the jugal insertion-plates are narrower than in the former. *Acanthopleura spiniger*, colour uniform greyish brown; jugum darker brown; anterior laminæ paler brown; posterior border of sutural laminæ coarsely grooved. *Acanthopleura incana*, colour uniform very dark brown to black; anterior laminæ same colour; posterior border of sutural laminæ slightly grooved. In C. the sutural laminæ become lighter anteriorly, the rim being nearly white.

Posterior valve.—Acanthopleura granulata, A. and B., 10 to 12 slits; teeth long, all green, or anterior tinged with brown; eaves short; colour white; jugum brown. *Acanthopleura* sp., C., 11 to 12 slits; teeth short, green, set more obliquely than the former, and with considerable symmetry with the median line, eaves long. The eaves are so long that when the valve is placed on a smooth surface and viewed on a level with the eye, the teeth are entirely hidden, whereas they are seen to nearly their whole extent in the former species; colour white and pale green; jugum small brown spot. *Acanthopleura spiniger*, 7 or 8 slits; teeth long, greenish; eaves short; colour, posterior border and jugum brown, between them a greenish band. *Acanthopleura incana*, teeth entirely absent; colour and

anterior laminæ very dark brown. In C. the sutural laminæ are paler anteriorly, the rim being nearly white.

The number of slits is too variable to make them of any value for descriptive purposes.

The shell of *Acanthopleura granulata* is ornamented with tubercles of fair size, which on the jugum become much smaller, and arranged in more or less regular concentric lines. There is a brown band on the jugum, separated from the greyish or brown sides by a narrow white band; the colour, however, is very variable, and may be lighter or darker; the anterior and posterior valves often have a dark lateral band.

The shell of *Acanthopleura* sp., C., is too rubbed to determine accurately; certainly with tubercles on the lateral portion of the intermediate valves and on the terminal valves; the dorsal aspect of the intermediate valves apparently smooth, with concentric lines of growth; colour pale buff, with a darker band along the jugum and at the sides.

Girdle.—Acanthopleura granulata, A. and B., crowded spines of variable thickness, a great number being considerably larger than the others: the usual arrangement of bands being a lateral black band for each of the first two valves, a broad black band for the fifth and sixth, and one for the eighth—or four bands on each side; the interspaces being greyish, with occasional patches of black, the most constant of which is a variable band opposite the seventh valve. *Acanthopleura* sp., C., the spines are much finer, shorter, and more uniform than in the former. There is a lateral black band for each of the first, second, seventh, and eighth valves, a broad band for the fifth and sixth, and traces for the third and fourth. The shells and girdles of *Acanthopleura spiniger* and *Acanthopleura incana* have already been described.

In all the West Indian forms the spines extend from the girdle as a narrow band between the valves; this can, however, only be seen after the removal of the valves. The same occurs in *Acanthopleura spiniger* (Challenger), but not in quite so marked a degree, and not at all in the Red Sea specimens, nor in *Acanthopleura incana*.

From the above analyses it seems clear that there are at least two species of the West Indian *Acanthopleura*.

In Gmelin's edition of the Systema Naturæ, two closely allied species are described on p. 3205, viz., No. 16, *Chiton granulatus:* "Ch. piceus supra planus, punctis elevatis numerosis in series digestis, limbo lato coriaceo spinoso: areis nigris albisque alternis. Chemnitz, Conchyl., vol. viii. pl. xcvi. fig. 806. *Habitat* in Oceano americano, *valvis* 8, *rarius* 7." No. 17, *Chiton piceus:* "Ch. testa octovalvi supra glabra picea nigro albidoque varia. Chemnitz, Conchyl., vol. viii. pl. xcvi. figs. 807–810; Chemnitz, Chit., pl. ii. figs. 6, 6 a, b, c. *Habitat* in Mari americano et rubro, granulato affinis, intus medio niger, ad latera virescens, maculis dorsi nigris et maculis fasciis venisque albidis aut virescentibus alternis, *valvis rarius*, 7 aut 6."

Gmelin considered these as distinct species, but the smoothness of the surface of the latter was almost certainly simply the result of erosion. The coloration of the under surface

accurately corresponds with specimen C. in the above tables. I have no hesitation in identifying *Chiton granulatus*, Gmel., with the *Acanthopleura* which appears to be so common at the Barbadoes (A. and B., *ante*); and it is equally probable that *Chiton piceus*, Gmel., is identical with my specimen C. I feel some hesitation in retaining that name for it; as, judging from its geographical distribution, Gmelin's form would include two distinct species. Blainville, however (Dict. des Sci. Nat., vol. xxxvi.), gives only the American locality, and, as has been above noted, the Red Sea species differs from any West Indian form.

Blainville[1] gives Gmelin's two species, and describes on p. 544 a new species, *Chiton convexus*, which is of very doubtful value.

Sowerby gives the following synonymy for *Chiton piceus* in the Conch. Illust., p. 1 :—"*Chiton convexus*, *Chiton granulatus*, *Chiton gemmatus*, *Chiton tuberculatus*, *Chiton unguiculatus*, *Chiton zonatus* (auctorum);" these are all Blainville's species (*loc. cit.*). Reeve[2] follows Sowerby in the synonymy, but it is not clear what species he intends, as in the Conchologia Iconica[3] *Acanthopleura spiniger* is referred to as *Chiton piceus*. Gray[4] refers to this species as "*Maugeria picea*, West Indies."

Reeve describes *Acanthopleura occidentalis* from the West Indies,[5] which is probably one of these two forms.

Acanthopleura spiniger and its varieties can now be distinguished from the other species without much difficulty.

The posterior valves alone separate *Acanthopleura incana* from all the preceding. The Japanese and Australian specimens of this form appear to have well-marked differences. It can only be decided after an examination of a greater number of specimens than I have studied, and of examples from intermediate localities, whether these distinctions are to be considered as specific or varietal. In the former case Gould's name must be retained for the Australian form,—he describes the interior of the shell as being "red and violet, somewhat iridescent," and certainly the madder-brown and pinkish colour of my specimens offers a marked contrast to the uniform black or blackish brown of the Japanese specimens. The laminæ of insertion are relatively smaller in the Australian form, and the sculpture of the shell appears to differ slightly, but my specimens are considerably eroded.

Except for the colour of the under surface, the posterior valve of *Acanthopleura incana* very closely resembles that of *Euplaciphora petholata*, Sow., also from South Australia. There may be some connection between the two forms, but the character of the insertion plates and the nature of the girdle sufficiently separate the two genera. It should not be forgotten that Carpenter divides the whole group of Chitons into Regular and Irregular, basing his classification upon the dissimilarity between the anterior and

[1] Dict. des Sci. Nat., 1825, vol. xxxvi. p. 545.
[2] Conch. Syst., 1842, p. 11.
[3] 1847, pl. xiii. fig. 70.
[4] Guide Moll., 1857, p. 184.
[5] Conch. Icon., 1847, pl. xix. fig. 76.

posterior valves. *Acanthopleura incanus* presents us with the anomaly of a Chiton with the anterior and intermediate valves quite similar to those of the "Regular" Acanthoidea, and with a posterior valve resembling that of the "Irregular" Placiphoroidea! An inspection of Carpenter's MS. proves that even at the time of his death he had not unravelled this admittedly difficult genus to his own satisfaction.

Dr A. T. de Rochebrune has recently briefly described, without figures, the following species:—*Acanthopleura quatrefagei*,[1] n. sp., Cape of Good Hope. *Acanthopleura vaillantii*, n. sp., Suez Canal; *Acanthopleura afra*, n. sp., Cape of Good Hope and Madagascar; *Acanthopleura rawakiana*, n. sp., Rawak, New Guinea; and *Acanthopleura balansæ*,[2] n. sp., Australia and New Caledonia.

Subgenus *Francisia*, Carpenter.

"Acanthopleura: valvis partim immersis, planatis; laminis centralibus pleurifissatis; sinu lobato" (Dall, 1882).

Francisia spinosa (Bruguière).

Chiton spinosus, Bruguière, Journ. d'Hist. Nat., 1792, vol. i. p. 25, pl. ii. figs. 1, 2.
" " Sowerby, Genera of Recent Shells, 1820–25, pl. cxxxix. fig. 1; and Conch. Illust., 1840, p. 1, pl. clxxv. fig. 151.
" " Reeve, Conch. Syst., 1842, vol. ii. p. 12, pl. cxxxiv. fig. 151; and Conch. Icon., 1847, pl. ix. fig. 51.
Maugeria spinosus, Gray, Guide Moll. Brit. Mus., 1857, p. 184.
Chiton spinosus, Adams, Genera Recent Moll., 1858, vol. i. p. 475.

Habitat.—Station 187. September 9, 1874. Lat. 10° 36′ S.; long. 141° 55′ E. Albany Island, Cape York, North Australia. 6 fathoms. Coral mud.
New Holland.

The shell has concentric lines of growth, and is roughened on the terminal valves and lateral areas, but is otherwise quite smooth. The laminæ of insertion are very large. There are about seventeen irregular slits in the anterior valve and twelve in the posterior; there is one lateral slit. The teeth are very long and finely grooved; eaves practically non-existent.

The upper surface of the shell is of a uniform black colour; the under surface of a lustrous madder pink. Insertion plates white.

[1] *Journ. de Conch.*, t. xxi. p. 42, 1881.
[2] *Bull. Soc. Philomath. Paris*, sér. 7, t. vi. pp. 192, 195, 197, 1882.

Section II.—CHITONES IRREGULARES. Irregular Chitons.

Tail plate abnormal, or with a sinus behind.

E.—Schizoidea.

Genus *Lorica*, H. and A. Adams.

Lorica volvox (Reeve).

Chiton volvox, Reeve, Conch. Icon., 1847, pl. vi. fig. 31.
„ *cimolius*, Reeve, Conch. Icon., 1847, pl. xxi. fig. 141.
Lorica cimolia, Adams, Gen. Recent. Moll., 1858, vol. i. p. 477, vol. iii. pl. liv. fig. 5.
„ „ Angas, Proc. Zool. Soc. Lond., 1867, p. 224.

Habitat.—Port Jackson, Sydney. 6 to 15 fathoms.

Mr Angas first united these two species, but retained the name for the second form instead of for the one first described. It is a very well-marked species, of large size.

Other localities are Watson's Bay; Middle Harbour; Port Lincoln, South Australia and Tasmania.

Genus *Schizochiton*, Gray.

Schizochiton incisus (Sowerby).

Chiton incisus, Sowerby, Proc. Zool. Soc. Lond., 1841, p. 61.
„ „ Reeve, Conch. Icon., 1847, pl. viii. fig. 43.
„ *elongatus*, Reeve, Conch. Icon., 1847, pl. viii. fig. 40 a and b.
Schizochiton incisus, Gray, Proc. Zool. Soc. Lond., 1847, p. 169, and Guide to Moll., 1857, p. 183; Shuttleworth., Bern. Mittheil., 1853, p. 68; H. and A. Adams, Genera Recent Moll., 1858, vol. i. p. 477, vol. iii. pl. liv. figs. 6, 6 a; E. A. Smith, Voyage "Alert," 1884, p. 82.

Habitat.—Samboangan, Philippines. Three specimens.

Island of Zebu, Philippines (Cuming); Raine Island, Torres Strait (Ince); Clairemont and Bird Islands, North-East Australia (Coppinger).

Mr Smith has adopted the somewhat obvious suggestion of Carpenter (*fide* a tablet in the British Museum), that *Schizochiton incisus* and *Schizochiton elongatus* are forms of the same species. He has also given a short description of Dr Coppinger's specimens. The most remarkable feature of this species is the possession of a series of well-developed eyes along the ridges of the shell, for such the "minute blackish beads" have been demonstrated to be by Professor Moseley,[1] in whose paper will be found an account of the structure of these remarkably situated organs and of the branching papillæ (Megalæsthetes and Micræsthetes) which occur in the shells of other species of Chitons.

[1] *Quart. Journ. Micr. Sci.*, N. S., 1885, vol. xxv. p. 37.

F.—Placiphoroidea.

Plaxiphora, Gray.

Dall subdivides Gray's genus *Plaxiphora* (*Placiphora*, Carpenter and Dall) into three subgenera in addition to the genus proper, viz. (*a.*) *Fremblya*, H. Adams; (*b.*) *Euplaciphora*, Shuttleworth; and (*c.*) *Guildingia*, Carp. They all agree with the genus proper in having the insertion plates regular, ribbed behind; numerous slits in the anterior valve, one in the intermediate and none in the posterior valve, and small eaves. In *Plaxiphora* the teeth are slightly propped; there is a small sinus, and the sutural laminæ are joined; swollen ribs; girdle hairy, with regular pore-tufts. The type is *Plaxiphora carmichaelis*, Gray (=*Plaxiphora setiger*, King, from Patagonia). In *Fremblya* the teeth are excurved, the sinus broad and shallow, girdle as above, the outbending of the teeth being the distinctive character. The type is *Fremblya collei*, H. Adams, from Australia. In *Euplaciphora* the teeth are sharp, the sinus broad, deep, and spongy, the girdle with crowded hairs, but without pores. Type, *Euplaciphora petholata*, Sow., from South Australia. In *Guildingia* the teeth are sharp, very long, and smooth; the sinus broad, deep, spongy; the girdle encroaches on the valves, with pore-tufts and emarginate posteriorly. Type, *Guildingia obtecta*, Carp., from New Zealand, Mus. Cuming, No. 45.

As I have not the opportunity of critically examining these subgenera, I shall, for the present at all events, refer all the three species collected by the Expedition to the genus *Plaxiphora*. Carpenter admitted that a main distinction between this genus and *Euplaciphora* lay in the absence of sutural tufts in the girdle of the latter, but he described in his MS. *Plaxiphora simplex*, n. sp., as *Euplaciphora*, although, as is shown on Plate III. fig. 13 *b*, sutural tufts are present; and in the type-species of *Plaxiphora*, *Plaxiphora carmichaelis*, the numerous scattered tufts only imperfectly take on a sutural arrangement.

The species of this genus are confined to the Southern Hemisphere.

Plaxiphora carmichaelis (Gray)

Chiton carmichaelis, Gray, Spicilegia Zool., 1828, p. 6, and Wood, Index Test., Suppl., 1828, p. 1, pl. i. fig. 10.
„ *setiger*, King, Zool. Journ., 1830–1831, vol. v. p. 338, and Sowerby, Conch. Illust., 1841, No. 95, fig. 17.
„ *fremblii*, Broderip, Proc. Zool. Soc. Lond., 1832, p. 28, and Sowerby, Conch. Illust., 1841, No. 95, fig. 4.
„ *biramosus* (?), Quoy and Gaimard, Durville, Voy. "Astrolabe," Zool., 1834, vol. iii. p. 378; Atlas, pl. lxxiv. figs. 12–16.
„ *setiger*, Deshayes, Lamarck, Hist. Nat. Anim. s. vert., 1836, vol. vii. p. 513.
„ „ Reeve, Conch. Illust., 1842, vol. ii. p. 10, pl. cxxxi. fig. 4, and Conch. Icon., 1847, pl. ix. fig. 48a; var. *β*, fig. 48b (= *Plaxiphora fremblii*).

Plaxiphora carmichaelis, Gray, Proc. Zool. Soc. Lond., 1847, p. 68, and Guide Moll. Brit. Mus., 1857, p. 186.
Chiton setiger, Gould, Wilkes' U.S. Explor. Exped., 1852, vol. xii. p. 330, fig. 425 a, b.
Placiphora carmichaelis, Dall, Proc. U.S. Nat. Mus., 1878, p. 80.

Habitat.—Station 306A. January 2, 1876. Lat. 48° 27′ S., long. 74° 30′ W. South Chili. 345 fathoms. Blue mud. Bottom temperature 46°.

The following three species of Blainville's, *Chiton albidus*, *Chiton raripilosus*, and *Chiton costatus*,[1] are regarded by Sowerby and Gray as synonyms of this species, but neither propose to adopt one of Blainville's names. The second species is from an unknown locality, the other two apparently from South Australia. One or more of these may perhaps be more nearly allied to *Plaxiphora petholata*, Sow.

The *Chiton biramosus* of Quoy and Gaimard is certainly closely allied to this species, if, indeed, it be distinct. They obtained it from Tasman Bay, New Zealand.

All the other specimens are from the south-west of South America, Tierra del Fuego, and Strait of Magellan; var. *fremblii* is from Valparaiso, Chili, except Gould's, which came from "Orange Harbour," and Gray's, which is stated to come from the Cape of Good Hope. This is probably an error.

Plaxiphora simplex (Carpenter) (Pl. III. figs. 13, 13*a*–13*c*).

Euplaciphora simplex, Carpenter MS.

"Testa *Euplaciphoræ modestæ* simili; sed magis elevatâ, longiore; loricâ rudi, fusco-purpureo varie maculatâ; jugo rotundato; mucrone postico, planato; ar. lat. vix definitis; valvis rotundatis, suturis magnis; totâ superficie læviore, sæpius detritâ, subspongiosâ; intus, valvis post. laminis satis elevatis, satis sinuatis; valvis ant. 8—valvis cent. 1—fiss.; dent. acutis, vix suffultis; subgrundæ curtis, spongiosis; sinu valde angusto, lævi, planato. Zonâ pilulis minimis confertissimis quasi spongiosâ, pilis corneis longioribus ad suturas et sparsim instructâ.

"Long. 1·35, lat. ·7, div. 120°. Variat., long. 1·1, lat. ·65, div. 100.

"*Habitat.*—Tristan da Cunha (Mus. Cum., No. 2691)."

Habitat.—Tristan Island, Tristan da Cunha. Shore.

Station 135C. Off Nightingale Island, Tristan da Cunha. 100–150 fathoms.

Dr P. P. Carpenter unfortunately died without publishing this definition of his species, and having, through the courtesy of Dr Dall, had access to his manuscript, I have not hesitated to transcribe his account, as it is only right that he should have all the credit of his research. The specimens in the British Museum, to which he alludes, bear his manuscript name. The *Euplaciphora modesta*, to which Carpenter alludes, is a new species,

[1] Dict. des Sci. Nat., 1825, vol. xxxvi. pp. 547, 548.

thus described in his MS.: "Testa *Euplaciphoræ petholatæ* formâ, colore et indole simillimâ; sed ar. lat. minus definitis; sculpturâ, nisi punctulis undique creberrimis, nullâ; etc. *Habitat.*—Australia, Mus. Cum., No. 67; var. 66 also from Australia."

The four specimens collected by the Expedition are greatly corroded, and were overgrown with Nullipore; on the removal of the latter what little remains of the original surface of the shell is exposed.

Shell.—Smooth, simply marked with lines of growth, flat sides meeting at a variable angle.

Anterior valve.—Small, surface smooth. *Under surface* with eight slits, teeth fairly long, smooth and sharp; eaves short.

Intermediate valves.—*Central area:* smooth, flat. *Lateral areas:* inconspicuous, with two or three very faint radiating ridges. *Under surface:* with a median horizontal rib-like swelling; sutural laminæ broad, but not deep; jugal sinus wide and shallow; one lateral slit; eaves short.

Posterior valve.—Very small and flat, greatly corroded; umbo apparently flat and terminal; posterior border thickened. *Under surface:* sutural laminæ as in intermediate valves, but the jugal sinus is comparatively narrow and deep; slits and teeth absent; posterior border much swollen.

Girdle.—Very thick and fleshy, upper surface having a spongy appearance, owing to being beset with very short horny spines, which are scarcely raised above the surface; there are tufts of longer spines, three to nine in each tuft, opposite the sutures of the valves; these have no definite position round the anterior valve. Situated outside these are numerous scattered similar tufts, usually somewhat smaller in size, which pass into an imperfect peripheral fringe of spines (see Pl. III. figs. 13, 13*a*).

Colour.—All the valves of a uniform dark brown, with a pale (lilac) narrow triangular band along the jugum of the intermediate valves (and anterior area of the posterior valve).

Under surface of all the valves of a bluish green colour; laminæ of insertion paler.

Girdle.—Upper surface dark brown; under surface dusky orange.

Size.—Length, 40 mm.; breadth, 25 mm.; height, 10 mm.; angle, 125° to 135° (two specimens from 100 to 150 fathoms). Length, 25 to 35 mm.; breadth, 14 to 17 mm.; height, 8 to 9 mm.; angle, 90° to 110° (two shore specimens).

Plaxiphora carpenteri, n. sp. (Pl. I. fig. 8, Pl. III. figs. 8*a*–8*g*).

Habitat.—Tristan da Cunha.

Shell.—Smooth, the sides meeting at an angle of 105°.

Anterior valve.—With eight radiating ridges, not counting the swollen posterior borders. Numerous concentric minor ridges cause these ridges to be rugose. *Under surface* with nine slits, two being very close together; eaves short.

Intermediate valves.—Central area: smooth, with fine lines of growth; no distinct keel. *Lateral areas:* prominent, concentrically rugose, with a beaded ridge along the anterior border, and, to a less extent, along the posterior border. *Under surface* with a median horizontal rib-like swelling; sutural laminæ broad, but not deep; jugal sinus shallow; one lateral slit; eaves short.

Posterior valve.—Anterior area so large as to reduce the posterior area to a minimum; smooth; umbo minute, nearly terminal. *Posterior area* merely forms a concentrically grooved thickening of the posterior border of the valve. *Under surface:* sutural laminæ as before, but the jugal sinus is comparatively narrow and deep; slits and teeth absent; the posterior border is greatly swollen.

Girdle.—Closely beset with very minute horny spines. The specimen had been dried when I received it, and none of the longer spines, characteristic of other species, are observable; but I think I can discern traces of small sutural tufts.

Colour.—Anterior valve: a median triangular area, with the apex at the umbo, is of a kind of chocolate colour, which is variegated with minute zigzag grey lines; the lateral spaces are of a dark slate colour.

Intermediate valves.—Central area: Jugum pink; greenish towards the umbo when worn down. *Pleura* dark greenish brown, with irregular longitudinal green bands. *Lateral areas:* madder brown, blotched with brown.

Posterior valve.—Anterior area resembling the central areas; *posterior border* pinkish.

Under surface of all the valves pale bluish green; laminæ of insertion white.

Girdle.—Reddish brown.

Size.—Length, 14 mm.; breadth, 9 mm.; height, 4 mm.

This species, which is the handsomest of the genus, is dedicated to the memory of Dr P. P. Carpenter, whose great knowledge of the group is fully acknowledged by all those who work after him.

The sculpture of the shell, slight as it is, is sufficient to characterise this species.

G.—Mopaloidea.

Genus *Acanthochiton* (Leach), Herrmannsen.

Acanthochiton garnoti (Blainville).

Chiton garnoti, Blainville, Dict. des Sci. Nat., 1825, vol. xxxvi. p. 552.
„ „ Quoy and Gaimard, Voyage de l'Astrolabe, 1834, vol. iii. p. 401, pl. lxxiii. figs. 9–14.
„ *danielli*, Sowerby, Conch. Illust., 1841, p. 7, No. 91, pl. xliv. fig. 48.

Habitat.—Sea Point, near Cape Town. Shore. Seven specimens.

Sowerby (*loc. cit.*, p. 7) erroneously gives Peru as the locality of *Acanthochiton garnoti*. He says: "C. hirudiniformis, Sow., Zool. Proc., 1832, p. 59, Con. Illus., f. 23, 48, 142,

Garnoti, Bl. Peru. Ch. Danielli, Con. Illust., f. 48, which comes from the Cape of Good Hope, may prove to be a distinct species, but all our specimens are much worn." I have no means for deciding whether *Acanthochiton hirudiniformis* is a synonym of *Acanthochiton garnoti*, but Gray[1] is almost certainly incorrect in making *Acanthochiton zelandica*, Quoy and Gaim., a synonym. I am not acquainted with "*Acanthochiton hookeri*, Gray, Dieffenbach, p. 262."

H.—Cryptoidea.

No representatives of the Cryptoidea were collected by the Challenger Expedition.

I.—Chitonelloidea.

As there exists a certain amount of uncertainty concerning the generic subdivisions of this group, the following account may perhaps tend to elucidate the subject.

Burrow[2] published a description of *Cryptoconchus larvæformis*, an unpublished name which Blainville had given to a species in the British Museum, and of which one specimen is still extant (*fide* E. A. Smith).[3] The generic name of *Cryptoconchus* was at the same time given to *Cryptoconchus porosus*, Blainville, and the latter being generically distinct from *Cryptoconchus larvæformis* retains the generic appellation; being the first of the two species described and more answerable to the name.

Blainville[4] says, "Cryptoplax (*Moluscart.*): Sous-genre de l'ordre des oscabrions, établi par M. H. de Blainville, dans le supplément à l'Encyclopédie d'Edimbourg, pour des espèces qui ont tons les principaux caractères de ce genre, mais chez lesquelles le corps, etroit alongé," &c. &c. But he does not refer to the name *Cryptoconchus* in Burrow's Elements. He says only two species are known, "*Cryptoplax larviformis*" and "*Cryptoplax depressus;*" and continues, "Dans ces deux espèces, dont on ignore la patrie il y a de chaque côté du dos une série de faisceaux de soie parfaitement symétriques." I have been unable to find the Encyclopædia article referred to, and Mr E. A. Smith informs me that he is unable to determine what is the *Cryptoplax depressus* of Blainville—it may be *Choneplax strigatus*, Sow.

Lamarck[5] describes *Chitonellus lævis* and *Chitonellus striatus*. To which Deshayes added in the second edition,[6] *Chitonellus fasciatus*, Quoy and Gaim., and *Chitonellus oculatus*, Quoy and Gaim.

[1] *Proc. Zool. Soc. Lond.*, 1847, p. 70.
The Elements of Conchology, 1815, p. 191.
[3] Rep. Zool. Collect. H.M.S. "Alert," 1884, p. 86.
[4] Dict. des Sci. Nat. Paris, 1818, tom. xii. p. 124.
[5] Histoire Naturelle des Animaux sans Vertèbres (ed. 1), 1819, vol. vi p. 317.
[6] *Ibid.*, 1836, vol. vii. p. 482.

Blainville[1] attributes the genus *Oscabrelle* to Lamarck, with *Chitonellus lævis* as its type, and the genus *Chitonelle* to himself, with *Chitonelle larvæformis*.

These facts may be tabulated thus :—

1815 *Cryptoconchus porosus*, n. sp., Blainv. (Burrow), genus and species retained.
„ „ *larvæformis*, n. sp., Blainv. (Burrow), species retained.
1818 *Cryptoplax larviformis*, Blainv. (Blainville), genus retained.
„ „ *depressus*, n. sp. (Blainville), species unrecognised.
1819 *Chitonellus lævis*, n. sp. (Lamarck), species most probably a synonym for *Cryptoplax larvæformis*.
„ „ *striatus*, n. sp. (Lamarck), species retained.
1825 *Oscabrelle lævis*, Lam. (Blainville).
„ *Chitonelle larvæformis*, Blainv. (Blainville).
1836 *Chitonellus lævis*, Lam., *Chitonellus striatus*, Lam., *Chitonellus fasciatus*, Quoy and Gaim., *Chitonellus oculatus*, Quoy and Gaim. (Deshayes).

From this it is clear that *Cryptoplax* takes precedence of *Chitonellus* and must be used for pore-bearing species, *Cryptoplax larvæformis*, Blainv., being the type species. The name *Chitonellus* may be retained for those species without pores if it should be deemed advisable to maintain this distinction.

I find that the late Dr P. P. Carpenter had arrived at a similar conclusion, as in his MS. he states, "There being two names in use for the group, I have kept Lamarck's name (the best known) for the non-porous and Blainville's for the pore-bearing species."

Owing to the fact of pores having now been proved to occur in *Chitonellus striatus* (see p. 40), all the species mentioned above must be relegated to the genus *Cryptoplax*, with the doubtful exception of *Chitonellus oculatus*.

The small size of the pores in this group and their tendency to disappear inclines me to consider that their presence or absence taken alone is a totally insufficient character upon which to found a generic distinction.

There is no need to enter into a discussion of any later generic synonymy, as none of the proposed names can stand.

Genus *Cryptoplax*, Blainville.

Cryptoplax larvæformis, Blainville (Pl. III, figs. 12*a*–12*m*).

Cryptoconchus larvæformis, Blainville, Burrow's Elements of Conchology, 1815, p. 191, pl. xxviii. figs. 2–4.
Cryptoplax larviformis, Blainville, Dict. des Sci. Nat., 1818, vol. xii. p. 124.
Chiton chitonellus, Blainville, Dict. des Sci. Nat., 1825, vol. xxxvi. p. 550.
„ *vermiformis*, Blainville, Dict. des Sci. Nat., 1825, vol. xxxvi. p. 553.
Chitonelle larvæformis, Blainville, Manuel de Malacologie, 1825, p. 603, pl. lxxxvii. fig. 6.
Chiton fasciatus, Quoy and Gaimard, Voyage de l'Astrolabe, Zool., 1834, vol. iii. p. 408, pl. lxxiii. figs. 21–29.
Chitonellus fasciatus, Deshayes, Lamarck's Hist. Nat. Anim. s. Vert., 1836 (ed. 2), vol. vii. p. 482.

[1] Manuel de Malacologie, 1825, p. 603.

Chitonellus lævis (?), Lamarck, Hist. Nat. Anim. s. Vert., 1819 (ed. 1), vol. vi. p. 317; Blainville, 1825 (*loc. cit.*), p. 603, pl. lxxxvii. fig. 5; Deshayes in Lamarck, 1836 (*loc. cit.*), p. 481; Reeve, Conch. Syst., 1842, pl. cxxxv. fig. 2 (not of Reeve, Conch. Icon., 1847, fig. 1, which is *Choneplax strigatus*, Sow.).

„ *fasciatus*, Reeve, Conch. Syst., 1842, vol. ii. pl. cxxxv. figs. 3, 4 (not fig. 5, which is *Chitonellus oculatus*).

„ „ Reeve, Conch. Icon., 1847, fig. 2 a, b.

Not *Chitonellus larvæformis*, Reeve, Conch. Icon., fig. 3, which is *Chitonellus burrowi*; Smith, Report Zool. Collect. of H.M.S. "Alert," 1884, p. 85.

Chitonellus fasciatus, Gould, U.S. Explor. Exped., 1852, vol. xii. p. 333; Atlas, pl. xxviii. figs. 429, 429a.

Chiton eruciformis, Sowerby, Genera Recent and Fossil Shells, 1820–1825, No. 12, pl. cxxxix. fig. 5.

Crytoplax fasciata + larviformis, Adams, Genera of Recent Mollusca, 1858, vol. i. p. 484; vol. iii. pl. lv. figs. 6, 6a.

Habitat.—Kandavu, Fiji. Shallow water.

Tongatabu, Friendly Islands (Quoy and Gaimard); Dalaquete, Zebu, Philippines (Cuming).

There can be little doubt that *Chitonellus larvæformis*, Blainv., is the same species as *Chiton fasciatus*, Quoy and Gaim., which latter has been copied and redescribed by Lamarck, Reeve, Gould, and others. E. A. Smith has recently shown that the *Chitonellus larvæformis* of Reeve is not that species, but a new one which he named *Chitonellus burrowi*; Mrs Gray's figures of *Cryptoplax larviformis* (*sic*) [1] are copied from Blainville, and those of *Cryptoplax fasciatus* [2] from Quoy and Gaimard, and J. E. Gray himself [3] referred to these as separate species. *Chitonellus lævis*, Lam., is believed by E. A. Smith to be this species. No mention is made of tufts of spines ("pores"). Blainville's figure in the "Manuel" of *Chitonellus larvæformis* is very rough, and there is no indication of the transverse bands on the girdle, but he figured the tufts, and being aware of their existence in one form, he might be expected to look out for them in the other, hence his silence on that point is worthy of note. Deshayes, in the second edition of Lamarck's work, admits Blainville's figure as a representation of *Chitonellus lævis*, and he ignores the pores. Whatever this species may prove to be, Reeve [4] is clearly in error in referring *Chiton strigatus*, Sow., to it; in the Conch. Syst.[5] he names Sowerby's species *Chitonellus strigatus*. Dall [6] refers to this as the type species of the genus *Choneplax* of Carpenter. E. A. Smith is undoubtedly correct in regarding *Chiton eruciformis*, Sow., as a synonym of this species. Sowerby did not believe in the generic distinction of *Chitonellus* from *Chiton*, so he re-named what he believed to be *Chitonellus lævis*, Lam., as *Chiton eruciformis*, as, though he does not say so, the specific name was pre-occupied (*Chiton lævis*, Penn.). This figure of the detached valves is copied in Reeve's Conch. Syst., where it is referred back to *Chitonellus lævis*, Lam.

[1] Figures of Molluscous Animals, 1859, vol. ii. pl. clxxxix. figs. 4, 4a. [2] *Ibid.*, figs. 5, 5a.
[3] Guide to the Systematic Distribution of Moll. in the British Museum, 1857, p. 187.
[4] Conch. Icon., fig. 1. [5] Pl. cxxxv. fig. 6. [6] *Proc. U.S. Nat. Mus.*, 1881, p. 288.

Quoy and Gaimard (*loc. cit.* p. 409) state: "Il est probable que neuf spiracules accompagnent les valves de chaque côté; mais nous n'avons jamais pu en voir cinq." As they were on their guard we must admit their statement as being beyond doubt; of course they figure only five.

In one of the specimens collected by the Expedition, the anterior five pairs of tufts are readily seen, as is also the sixth tuft on the right side, but that on the left side is not visible, nor the seventh or eighth pairs. Their apparent absence may, however, be possibly accounted for by the fact that the skin is much wrinkled in the places where they might be expected to occur; but this does not apply to the interspace between the last two valves, which is quite smooth and yet exhibits no trace of a tuft.

Deshayes (*loc. cit.* Lamarck, ed. 2, p. 482) says of *Chiton fasciatus*, Quoy and Gaim., "Sur l'extrémité antérieure on remarque de chaque côté cinq ocelles d'un brun assez foncé."

Reeve figures the pores,[1] but in the otherwise much better figure of the same species (*Chiton fasciatus*) in the Conch. Icon., fig. 2b, they are omitted, as is also the case in fig. 2a, and no mention is made of them in the text. The normal number of pores is present in the British Museum specimens, hence Reeve's silence on this point can only be attributed to carelessness.

Gould refers his specimen to *Chiton fasciatus*, Quoy and Gaim. He is probably correct in his identification, but his account is imperfect and does not correspond with the figures. He makes no mention of pores.

The brothers Adams[2] define the genus *Cryptoplax* as having the "mantle spinulose, encircled with a series of setigerous pores." They include *Cryptoplax striatus* and *Cryptoplax oculatus* and others in the same genus, although pores have not heretofore been shown to occur in the former. They give a fair figure of *Cryptoplax fasciatus*, with the nine lateral pores and a supernumerary one in front.

In most cases the silence of authors concerning the presence or absence of pores or tufts is not to be taken as an argument for their absence, as they are always small and are often scarcely, if at all, visible in old and rubbed, dry specimens.

The only conclusion at which we can arrive at in this species is that normally nine pairs of tufts are present, but that in some specimens more or fewer of the posterior pairs may be absent. This further leads us to the supposition that they may be entirely absent, although we have at the present time no direct evidence in support of the last alternative.

Cryptoplax striatus (Lamarck) (Pl. I. fig. 9, Pl. III. figs. 9*a*–9*m*).

Chitonellus striatus, Lamarck, Hist. Nat. Anim. s. vert. (ed. 1), 1819, vol. vi. p. 317, and (ed. Deshayes) 1836, vol. vii. p. 481.

" " Sowerby, Genera of Shells, 1820–1825, No. 12, pl. cxxxix. fig. 4.

[1] Conch. Syst., vol. ii. pl. cxxxv. fig. 4.

[2] Genera of Recent Mollusca.

Chiton striatus, Blainville, Dict. des Sci. Nat., 1825, vol. xxxvi. p. 551.
Chitonellus striatus, Sowerby, Conch. Illust., 1841, p. 7, No. 85, fig. 62.
„ „ Reeve, Conch. Syst., 1842, vol. ii. pl. cxxxv. fig. 1; Conch. Icon., 1847, fig. 4 a, b.
„ *gunnii*, Reeve, Conch. Icon., 1847, fig. 5.
„ *rostratus*, Reeve, Conch. Icon., 1847, fig. 6.
„ *oculatus*, Reeve, Conch. Icon., 1847, fig. 7 a, b (not of Quoy and Gaimard).
Cryptoplax striata + gunnii + rostrata, Adams, Genera of Recent Mollusca, 1858, vol. i. p. 484.
„ „ Angas, Proc. Zool. Soc. Lond., 1867, pp. 224, 225.
Chitonellas striatus, Smith, Report Zool. Collections H.M.S. "Alert," 1884, p. 84.

Habitat.—Port Jackson, Sydney. 6 to 15 fathoms.

This form is the best known of the group, but even it has suffered at the hands of systematic conchologists. Reeve, as Angas and E. A. Smith have previously suggested, has increased the synonymy of the species by three names, viz., *Cryptoplax gunnii*, *Cryptoplax rostratus*, and *Cryptoplax oculatus*. E. A. Smith recognises in the first of these a fairly well-marked variety of *Cryptoplax striatus*, which occurs in Tasmania and South Australia.

The figure in Sowerby's Genera, and which is copied in Reeve's Conch. Syst., is not at all characteristic, as the three posterior valves are placed so far apart; but Deshayes, in the second edition of Lamarck's work, accepts it as representing this species.

Although this species has been described and figured so often, it has, so far as I am aware, hitherto escaped conchologists, that a series of "pores" exists, which have the same position as those in *Cryptoplax larvæformis*. It is, however, easy to understand how this has been the case: the number and size of the spines in the pores, in the latter species, vary considerably. They arise from a very shallow depression, which appears under a lens as a small roundish bare spot, but the white colour of the spines causes them to be more conspicuous than they would otherwise be. In *Cryptoplax striatus* the white spines very rarely occur, and when they do they are very small; the bare shallow depressions have much the same character as in the other species; they are, however, often very hard to detect, and even appear to be of irregular occurrence. In all the eight spirit specimens I have examined, I find that the four anterior pores, and those between the first and second valves, are universally present, and I could distinguish them between the second and third, and third and fourth valves, in nearly all. The hinder pores are more difficult to make out, and only in two cases could I satisfy myself of their occurrence between the seventh and eighth valves. The main reason of their having been overlooked is due to the fact that dried specimens alone have almost invariably been studied, and in these the pores disappear, but very occasionally they can be traced when they are carefully looked for. The presence of these pores breaks down a distinction which has been made between pore-bearing and aporous forms.

Cryptoplax oculatus (Quoy and Gaimard) (Pl. I. fig. 10, Pl. III. figs. 10*a*-10*m*).

Chiton oculatus, Quoy and Gaimard, Voyage de l'Astrolabe, Zool., 1834, vol. iii. p. 410, pl. lxxiii. figs. 37, 38.

Chitonellus oculatus, Deshayes, Lamarck's Hist. Nat. Anim. s. vert., 1836 (ed. 2) vol. vii. p. 482.

Chitonellus fasciatus, Reeve (not of Quoy and Gaimard), Conch. Syst., 1842, vol. ii. pl. cxxxv. fig. 5 (only).

Not *Chitonellus occulatus*, Reeve, Conch. Icon., 1847, figs. 7a, 7b (= *Cryptoplax striatus*).

Habitat.—Samboangan, Philippine Islands. 10 fathoms.

"Chiton, corpore parvo, æqualiter villoso, roseo, duabus fasciis nigris cincto; valvis glaucis, longitudinaliter sulcatis; tribus anticis ovatis, pillis nigris et albis cinctis.

"Petite espèce qui se distingue de la précédente [*Chitonellus fasciatus*, Quoy and Gaim.], ainsi que des deux indiquées par M. de Lamarck [*Chitonellus lævis* and *Chitonellus striatus*], par sa forme moins cylindrique, ses deux extrémités moins obtuses, plus aplaties; par son corps uniformément couvert de soies plus longues et plus serrées que dans les espèces ci-dessus; enfin par ses trois premières valves, ovalaires, glauques, entourées d'un cercle de soies noires, et d'un autre plus extérieur de blanches, ce qui donne une apparence d'yeux à ces pièces; les autres, plus rétrécies, séparées, onguiculées, sont rouge-brun. Toutes, moins la première, sont sillonnées parallèlement en long, avec un triangle lisse au milieu. Il est probable que leur lame d'insertion est la même que dans l'Oscabrion fascié, ce dont nous n'avons pas voulu nous assurer, pour ne pas gâtes le seul individu que nous possédons. Sa couleur est rougeâtre, avec deux bandes noires transversales confluentes sur le dos. Le dessous est jaunâtre. La bouche est entourée d'un voile ovalaire, frangé. Les branchies occupent un peu moins que le tiers postérieur du corps; elles ont chacune vingt lamelles.

"Nous croyons que cet Oscabrion provient de la Nouvelle-Guinée ou de Vanikoro.

"*Dimensions.*—Longueur, 2 pouces, 6 lignes; circonférence, 1 pouce, 5 lignes."

It is very strange, with such a good description as the foregoing of the external appearance of this handsome form, that Reeve and other conchologists should have relegated other forms to this species. In no systematic work or collection of specimens which I have seen has this species been properly identified. Externally, *Cryptoplax oculatus* bears no resemblance to *Cryptoplax striatus*, with which Reeve confounded it, but it does resemble *Cryptoplax larvæformis* in many respects, and it would be very difficult, on a merely superficial examination, to distinguish between rubbed specimens of the two forms. I have seen undoubted examples of *Cryptoplax oculatus* identified as *Cryptoplax larvæformis* in more than one public museum; and Reeve himself figures [1] this species, with the characteristic border to the anterior valves, and the two median dark bands. His colouration is, however, very erroneous; thus with all the species before him, Reeve figures *Cryptoplax oculatus* as *Chitonellus fasciatus* (*Cryptoplax larvæformis*),

[1] Conch. Syst., vol. ii. pl. cxxxv. fig. 5.

in the Conch. Syst., and describes and figures *Cryptoplax striatus* as *Chitonellus oculatus* in the Conch. Icon. !

Mr E. A. Smith[1] states that he cannot identify any specimen in the British Museum with the species in question; but two specimens, at least, from the Friendly Islands occur in that collection. Mr Smith has kindly sent me a sketch of the isolated valves of one of these specimens, which I find perfectly corresponds with Pl. III. figs. 10*a*–10*m* of this Report.

Dr P. P. Carpenter in his MS. says—"The *oculatus* of Reeve appears to me a distinct species [from *Chiton oculatus*, Quoy and Gaim.]. He says nothing about pores."

Cryptoplax burrowi (E. A. Smith) (Pl. III. figs. 11*a*–11*m*).

Chitonellus larvæformis, Reeve (non Blainville), Conch. Icon., 1847, fig. 3.
„ *burrowi*, E. A. Smith, Report Zool. Collect. H.M.S. "Alert," 1884, p. 85.

Habitat.—Port Adelaide (Reeve); Straits of Macassar (Captain Belcher); Port Molle (Coppinger). All in the British Museum.

I have only to add to the description of this species, as emended by Smith, that nine pores are present on the girdle on each side in the normal position. On my inquiring specially on this point, Mr Smith kindly re-examined his specimens and informed me by letter that "*Chitonellus burrowi* has pores, and is therefore a *Cryptoplax*. There is no trace of them externally, and they are only discernible by removing the outer scaly coat; they are then seen (but not distinctly as in the other species) upon the white skin beneath in just the same position and to the same numbers as in *Cryptoplax larvæformis* and *Cryptoplax striatus*."

As the existing descriptions give a sufficiently accurate and recognisable account of the external appearance of the four species of *Cryptoplax* alluded to above, it would be superfluous to re-describe them. The appearance of the detached valves has not, however, been previously described, and it merits careful attention, since, as will be seen on referring to Pl. III. figs. 9–12, each species can be readily identified by even a single isolated valve.

There is in *Cryptoplax* a greater dissimilarity between the intermediate valves than occurs in other Chitons. In most other forms the second valve differs from the succeeding by being relatively much deeper (*i.e.*, longer), but otherwise it has the same general appearance as the other valves. In *Cryptoplax* the first three valves are usually much larger than the remainder. This is especially the case in *Cryptoplax larvæformis*. In *Cryptoplax striatus* the third and succeeding valves are pretty much of the same size, whereas in the other three species the last four valves are considerably smaller. This statement merely refers to the exposed portion of the valves. In *Cryptoplax striatus* all the valves may overlap or the last four may be slightly separated. The other species

[1] Report Zool Collections, H.M.S. "Alert," p. 85

are characterised by the last four valves being considerably isolated, the distance between them varying with the contraction or extension of that region of the body. On this subject M. de Rochebrune says : " La position isolée des valées a été tout aussi mal interprétée ; *douze espèces* de Chitonelles et *soixante et un individus* de ces espèces sont sous nos yeux, toutes à l'exception des *Cryptoplax fasciatus*, Quoy et Gaim., et *oculatus*, Quoy et Gaim., ont les valves imbriquées, et même ces deux espèces n'ont de réellement isolées que les trois valves postérieures." [1]

The valves of *Cryptoplax* consist of a small tegmentum resting like a cap upon the well-developed articulamentum. The articulamentum may perhaps be best described, for all the valves except the first, as resembling a heart-shaped or sagittate scoop, the emargination being in front. The posterior border is always entire and often greatly thickened, and it may be squared, rounded, or pointed ; the bowl of the scoop may be comparatively flat, or the two sides may meet at a sharp angle. The anterior wings constitute the laminæ of insertion of the valve, and are unslit at the sides or behind in the terminal valve.

The anterior valve is oval in shape, but more or less squared posteriorly ; the articulamentum is also scoop-shaped, and its posterior border may be enormously thickened ; the anterior projection forms the lamina of insertion of this valve, which here alone is slit, there being three slits, forming two central broad teeth. The tegmentum may leave a larger or smaller amount of the articulamentum exposed on a dorsal view, and on the under surface it is seen to wrap round the hinder edge of the articulamentum, as is usually the case in other Chitons. The upper surface of the valve is usually much corroded, and its sculpture generally appears to consist of irregular granules and to differ slightly from that of the other valves.

The tegmentum of the remaining valves has a more or less pyriform or oval contour ; it always leaves the laminæ of insertion largely exposed ; posteriorly it usually forms a sort of cap or clothing to the apex or rounded end of the articulamentum, and thus is generally apparent on an under view of the valve, where it has some resemblance to the calyx of a flower. In all the valves the jugum is distinguished as a more or less smooth elongated triangle, the pleura being granular and irregularly grooved, the grooves radiating from the posterior umbo. There are no lateral areas.

The above general account will serve to explain the drawings on Plate III., and on reference to these the differences between the valves of the one species or between corresponding valves of the four species will be readily apparent, so that there is no need to enter into minute description or comparison of the several valves.

The first three and the last valves have alone been figured, as differences between the remainder and the third are of no great importance or interest ; each of these valves has been drawn as seen from above, from below, and from the side. The first three species are drawn from specimens collected by the Challenger Expedition. Mr Smith kindly

[1] *Ann. des Sci. géol.*, vol. xiv. p. 11.

made a sketch of the isolated valves of a specimen of what I had previously identified as *Cryptoplax oculatus* in the British Museum, which perfectly agrees with my figs. 10*a*–10*m*, and I am also greatly indebted to him for figs. 12*a*–12*m*, which represent the detached valves of his species (*Cryptoplax burrowi*), also in the British Museum, which enables me to illustrate all the species of *Cryptoplax* known to British zoologists.

On comparing the anterior valve of the four species, it is seen that the tegmentum is relatively largest in *Cryptoplax striatus*, and smallest in *Cryptoplax larvæformis*. The posterior border of the articulamentum is greatly thickened in this species and in *Cryptoplax oculatus*, but not so in the other species. This practically holds good also for the remaining valves.

In the seven posterior valves of *Cryptoplax striatus*, the anterior apex of the jugum of the tegmentum always projects beyond the jugal sinus. In *Cryptoplax burrowi* and *Cryptoplax oculatus*, it is more or less even with it, but in the latter, at least, it slightly projects in some valves; it never does so in *Cryptoplax larvæformis*, but a narrower or wider space is always to be found in front of the tegmentum.

The relative amount of articulamentum to tegmentum, exposed on a lateral view of the posterior valve, varies considerably; it is least so in *Cryptoplax striatus*, and most uncovered in *Cryptoplax larvæformis*. *Cryptoplax burrowi* is unique in presenting the tegmentum as entirely surrounded by the articulamentum when viewed from above.

The sculpture of the three first species is, on the whole, very similar; but in *Cryptoplax larvæformis* the jugum is not definitely marked, and the surface of the shell appears to be smooth, with concentric lines of growth.

All the species, except *Cryptoplax oculatus*, are now known to be furnished normally with sutural pores, and it is most probable that they will yet be found to occur in that species.

In most of the points above mentioned, a distinct series can be traced, *Cryptoplax striatus* being the least specialised; *Cryptoplax burrowi* follows, while *Cryptoplax oculatus* is intermediate between this species and the highly specialised *Cryptoplax larvæformis*.

The British Museum contains specimens of only the four species above mentioned, and, so far as I am aware, no other species occur in other British collections. Dr A. T. de Rochebrune of the Muséum d'Histoire Naturelle in Paris, has given short Latin diagnoses of the following species:—*Cryptoplax montanoi*, n. sp., from Borneo; *Cryptoplax peroni*, n. sp., from Australia; *Cryptoplax torresianus*, n. sp., from Torres Straits; *Cryptoplax caledonicus*, n. sp., *Cryptoplax heurteli*, n. sp., and *Cryptoplax unciniferus*, n. sp., from New Caledonia.[1] It is impossible to determine what relation these species bear to each other, and to the previously described forms, until we have figures of the whole animals and of the isolated valves, in addition to full and minute descriptions. In

[1] *Bull. Soc. Philom. Paris*, sér. 7, t. vi. pp. 190, 193, 195–197, 1882.

a monograph on the fossil Chitons, Rochebrune figures [1] a "valve médiane" of *Cryptoplax oculatus*, Quoy and Gaim. From its shape it must be a second valve, but it neither agrees with the original description of the valves by Quoy and Gaimard, nor with my specimen, and we are driven to the alternative that it represents the worn valve of another species, possibly of *Cryptoplax burrowi*, Smith.

In order to render this account of the Chitonelloidea as complete as my opportunities admit of, I now append extracts from Dall's valuable paper On the Genera of Chitons.[2]

"CHITONELLOIDEA.

"Tail plate funnel-shaped. Laminæ thrown forward." [3] *Chitonellus*, Blainv. [Lam.]—Insertion plates very sagittate; 5 [*sic*] slits in anterior valve, none in middle and posterior valves; teeth very short, except at sutures; eaves distinct; gills posterior; sinus very deep and narrow; girdle, crowded bristles, no tufts; body very long; hind valves separate.[4]

The subgenus "*Cryptoplax*, Gray" [Blainv.], precisely resembles above, except that there are small tufts.

Choneplax, Carp.—Insertion plates intermediate; 5 slits in anterior valve, 1 in middle and posterior valves; teeth moderately long in front; eaves minute; gills (?); sinus very deep and narrow; girdle gravelly, with sutural tufts; valves touching.[4]

On page 288 there is the following definition of this genus:—"Animal repens, satis elongatum: valvæ expositæ parvæ, omnino contiguæ; valva postica infundibuliformis; mucro retrojectus, terminalis; laminæ ut in *Katherina* sed obsoletim fissatæ; zona Acanthochitonoidea. Type *Chiton strigatus*, Sowerby. West Indies."

Subgenus *Chitoniscus*, Carp. "49*a*. Animal et testa Choneplacis similes sed zona haud porifera."

"Based on *Chitonellus striatus* and *strigatus*, Sowerby, Conch. Ill., figs. 62, 63, which are represented as without pores. In the former the valves are separated (as in *Notoplax*); in the latter they touch (as in *Choneplax*)." As Dall truly observes, "The species need examination to confirm the accuracy of the figures."

The relationship of the Chitonelloidea to the other Chitons has always been a subject of controversy. The tendency of those modern authors who have approached the subject with what may be termed a morphological bias is to regard the former as the most primitive division of the group.

Professor Hubrecht, for example, says: "This genus [*Cryptoplax*] was long looked upon as representing a reduced stage in comparison with Chiton; different details of its organisation (branchiæ, foot, &c.) show the inconsistency of this proposition, and of all

[1] *Ann. des Sci. géol. Paris*, vol. xiv. pl. iii. fig. 14.
[2] *Proc. U.S. Nat. Mus.*, 1881, pp. 279–291.
[3] *Op. cit.*, p. 285.
[4] *Op. cit.*, pp. 289, 291.

Chitons it must certainly be looked upon as the more primitive and the more closely related to the Solenogastres."[1]

On the other hand, Dall finds "in *Chitonellus fasciatus* the representative of the most highly developed type of Chiton."[2]

The shell is remarkable in many ways, not least for the great development of the articulamentum as compared with the tegmentum, and, with the exception of three slits in the anterior valve, all the insertion plates are unslit.

The structure of the shell indicates that the Leptochitons are the most primitive forms. In the group of the Leptoidea, the sutural laminæ are small and are present in all the valves except the first, but the laminæ of insertion first appear on the terminal valves only, next on the intermediate valves also, in all cases they are small and never slit. In all other Chitons the insertion plate of the anterior valve is slit, but in *Cryptoplax* alone the lateral insertion plate is unslit. *Cryptoplax* agrees with some of the Acanthoidea and with the Schizoidea and Placiphoroidea in having the insertion plate of the terminal valve also unslit. It is probable that this condition has been independently acquired in several of these instances, whereas in *Cryptoplax* it is possibly a primitive condition.

The scales of the girdle in the Leptoidea are delicate and scattered, and in the higher members of the series (*Hanleyia* and *Hemiarthrum*) small sutural tufts appear, and in the latter, at all events, there are anterior tufts as well. The presence of sutural tufts appears to be quite irregular, even in closely allied forms; as, for instance, among the subgenera of Plaxiphora and in the genus *Cryptoplax* itself. We may conclude then that the possession of tufts is not of very great importance, at all events when they are feebly developed, and especially when they have a tendency to disappear. It must not be forgotten that there are amongst the Ischnoidea forms with and without girdle pores; in *Angasia* there are stated to be sutural hair-tufts. It may be that, with the exception of the Leptoidea, the pore-bearing forms represent the lower members of their series.

The microscopical structure of the spines of the girdle of *Cryptoplax* (*Cryptoplax larvæformis* and *Cryptoplax striatus*) is identical with that of *Acanthochiton* (*Acanthochiton discrepans*, Brown, and *Acanthochiton garnoti*, Blainv.), and differs from that of all the other species of Chitons which I have as yet examined. These spines may fairly rank as the most specialised in the whole group.

The great thickness of the girdle itself in *Cryptoplax* certainly recalls the thick spiniferous body wall of the shell-less Isopleura, and the comparatively narrow foot lying within the pallial groove bears but slight resemblance to the incipient foot of *Chætoderma* or *Proneomenia*.

The gills present us with some points of interest. In *Proneomenia* amongst the shell-less forms gills are entirely absent, respiration, according to Hubrecht, probably taking place all along the wall of the intestine and the foot, and perhaps more especially in the

[1] *Quart. Journ. Mic. Sci.*, 1882, p. 214. [2] *Proc. U.S. Nat. Mus.*, 1878, p. 314.

rectum. Respiration is effected in *Neomenia* by about thirty ciliated folds in the rectum, in *Chætoderma* the gills are paired, the anal opening lying between them. The few gills situated on each side of the anus in the Leptoidea is but a slight advance, and from this condition there is a complete series to the long row of closely-set gills of the most specialised Chitons, other details of structure tending to prove that the extent of the gill-row is one indication of specialisation. In *Cryptoplax* the gills extend to about one-third to one-half of the length of the foot, and thus constitute a distinct advance upon Leptochiton.

On the whole, then, it would appear that the genus *Cryptoplax* is a highly specialised branch of a low group of Chitons, but there are not yet sufficient data to indicate the exact relationship of the genus. The limited Australasian distribution of the genus, so far as that is of any value, supports this conclusion. Carpenter, Dall, and Rochebrune deny that any fossil representatives of the genus are known.

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PLATE I.

PLATE I.

Figure 1.—*Leptochiton benthus*, n. sp.

„ 2.—*Leptochiton belknapi*, Dall.

„ 3.—*Leptochiton kerguelensis*, n. sp.

„ 4.—*Hemiarthrum setulosum*, Carp.

„ 5.—*Lepidopleurus dorsuosus*, n. sp.

„ 6.—*Lepidopleurus dallii*, n. sp.

„ 7.—*Chiton murrayi*, n. sp.

„ 8.—*Plaxiphora carpenteri*, n. sp.

„ 9.—*Cryptoplax striatus*, Lam. (Drawn by the Author.)

„ 10.—*Cryptoplax oculatus*, Quoy and Gaim.

Fig. 1.

Fig. 2.

Fig. 3.

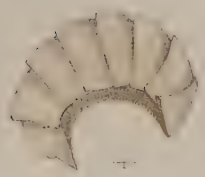

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

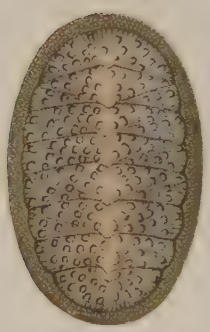

Fig. 10.

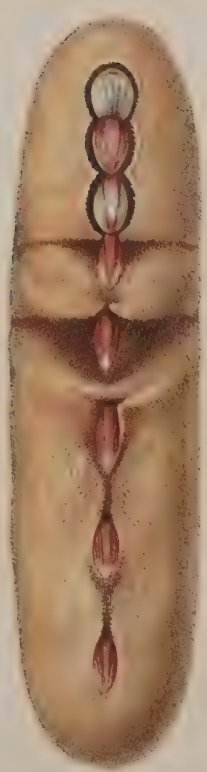

Fig. 9.

Fig. 8.

T. H. Thomas del. F. Huth, Lith^r Edin

1, LEPTOCHITON BENTHUS, n. sp. 2, LEPTOCHITON BELKNAPI, Dall. 3, LEPTOCHITON KERGUELENSIS, n. sp.
4, HEMIARTHRUM SETULOSUM, Carpenter. 5, LEPIDOPLEURUS DORSUOSUS, n. sp. 6, LEPIDOPLEURUS DALLII, n. sp.
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10, CRYPTOPLAX OCULATUS, Quoy & Gaimard.

PLATE II.

PLATE II.

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„ 1*b*. —Lower surface of first two valves × 6 diam.
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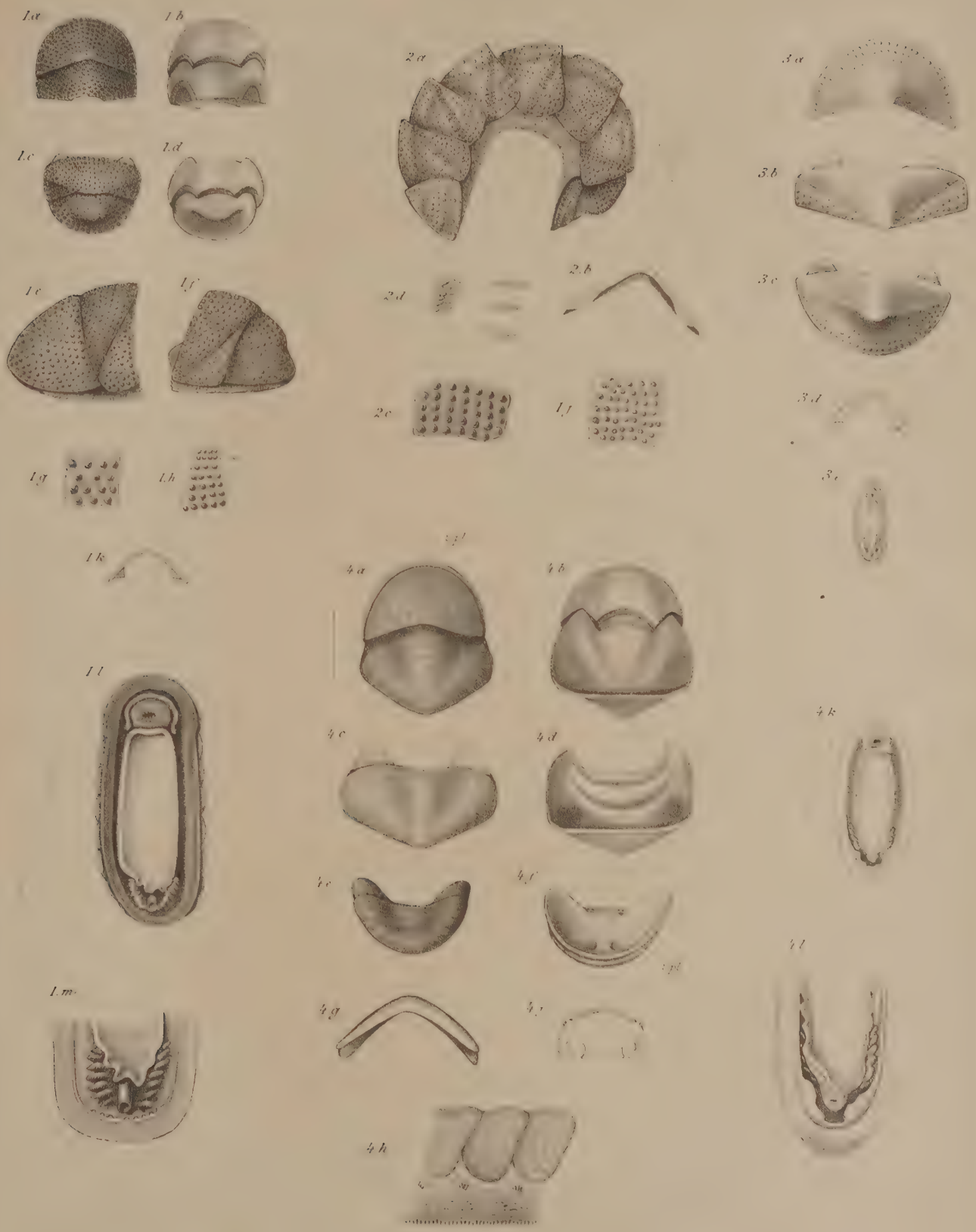

A.C.Haddon del.

F.Huth, Lith.r Edinr.

1a-1m, LEPTOCHITON BENTHUS, n.sp. 2a-2d, LEPTOCHITON BELKNAPI, Dall.
3a-3c, LEPTOCHITON KERGUELENSIS, n.sp. 4a-4l, HEMIARTHRUM SETULOSUM, Carpenter.

PLATE III.

PLATE III.

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„ 6*f*.—Under surface of posterior valve × 5 diam.
„ 6*g*.—Half of upper surface of an intermediate valve × 10 diam.
„ 6*h*.—Portion of girdle.
„ 6*i*.—Angle of an intermediate valve × 10 diam.

Figures 7*a–e.*—*Chiton murrayi*, n. sp.

Figure 7*a*.—Under surface of anterior valve × 7½ diam.
„ 7*b*.—Half of under surface of an intermediate valve × 7½ diam.
„ 7*c*.—Under surface of posterior valve × 7½ diam.
Figure 7*d*.—Portion of upper surface of the shell, highly magnified.
„ 7*e*.—Isolated scales from girdle, highly magnified.

Figures 8*a–g.*—*Plaxiphora carpenteri*, n. sp.

Figure 8*a*.—Upper surface of anterior valve × 4 diam.
„ 8*b*.—Under surface of anterior valve × 4 diam.
„ 8*c*.—Upper surface of an intermediate valve × 4 diam.
Figure 8*d*.—Under surface of an intermediate valve × 4 diam.
„ 8*e*.—Upper surface of posterior valve × 4 diam.
„ 8*f*.—Under surface of posterior valve × 4 diam.
„ 8*g*.—Half of upper surface of second valve × 8 diam.

Figures 9*a–m.*—*Cryptoplax striatus*, Lam. 2 diam.
„ 10*a–m.*—*Cryptoplax oculatus*, Quoy and Gaim. × 4 diam.
„ 11*a–m.*—*Cryptoplax burrowi*, E. A. Smith. These figures were drawn by Mr Smith × 3 diam.
„ 12*a–m.*—*Cryptoplax larvæformis*, Blainv., natural size.

Figure *a*.—Upper surface of first valve.
„ *b*.—Under surface of first valve.
„ *c*.—Side view of first valve.
„ *d*.—Upper surface of second valve.
„ *e*.—Under surface of second valve.
„ *f*.—Side view of second valve.
Figure *g*.—Upper surface of third valve.
„ *h*.—Under surface of third valve.
„ *i*.—Side view of third valve.
„ *k*.—Upper surface of last valve.
„ *l*.—Under surface of last valve.
„ *m*.—Side view of last valve.

Figures 13, 13*a–c.*—*Plaxiphora simplex*, Carp. MS.

Figure 13.—Side view, natural size.
„ 13*a*.—Under surface, natural size.
Figure 13*b*.—Sutural tuft, greatly magnified.
„ 13*c*.—Peripheral tufts, greatly magnified.

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5a-5i, LEPIDOPLEURUS DORSUOSUS, n.sp. 6a-6i, LEPIDOPLEURUS DALLII, n.sp. 7a-7e, CHITON MURRAYI, n. sp.
8a-8g, PLAXIPHORA CARPENTERI, n. sp. 9a-9m, CRYPTOPLAX STRIATUS, Lamarck. 10a-10m, CRYPTOPLAX OCULATUS, Quoy & G
11a-11m, CRYPTOPLAX BURROWI, E.A.Smith. 12a-12m, CRYPTOPLAX LARVÆFORMIS, Blainville. 13,13a-13c, PLAXIPHORA SIMPLEX, Carpen